



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/US97/23962  <b>(22) International Filing Date:</b> 23 December 1997 (23.12.97)  <b>(30) Priority Data:</b> 08/778,093                      2 January 1997 (02.01.97)                      US 08/958,281                      27 October 1997 (27.10.97)                      US  <b>(71) Applicant:</b> SAINT FRANCIS MEDICAL TECHNOLOGIES, LLC [US/US]; 231 Sandringham Road, Piedmont, CA 94611 (US).  <b>(72) Inventors:</b> ZUCHERMAN, James, F.; 3035 Price Street, San Francisco, CA 94123 (US). IISU, Ken, Y.; 52 Clarendon Avenue, San Francisco, CA 94114 (US). FALLIN, T., Wade; 210 East 200 South, Hyde Park, UT 84318 (US). KLYCE, Henry, A.; 231 Sandringham Road, Piedmont, CA 94611 (US).  <b>(74) Agent:</b> MEYER, Sheldon; Fliesler, Dubb, Meyer and Lovejoy LLP, Suite 400, Four Embarcadero Center, San Francisco, CA 94111-4156 (US).		<b>(81) Designated States:</b> AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.          Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>
<b>(54) Title:</b> SPINE DISTRACTION IMPLANT AND METHOD		
<b>(57) Abstract</b>  A spinal distraction implant as shown in the figure alleviates pain associated with spinal stenosis, and facet arthropathy by expanding the volume in the spine canal and/or neural foramen. The implant provides a spinal extension stop while allowing freedom of spinal flexion.		

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## SPINE DISTRACTION IMPLANT AND METHOD

### Introduction:

5 This application is a combination of parent and continuation-in-part U.S. patent applications, both entitled SPINE DISTRACTION IMPLANT AND METHOD, having U.S. Serial No. 08/778,093, filed on January 2, 1997 (parent), and U.S. Serial No. 08/958,281, filed on October 27, 1997 (continuation-in-part).

### 10 Background of the Invention:

As the present society ages, it is anticipated that there will be an increase in adverse spinal conditions which are characteristic of older people. By way of example, with aging comes increases in spinal stenosis (including but not limited to central canal and lateral stenosis),  
15 the thickening of the bones which make up the spinal column and facet arthropathy. Spinal stenosis is characterized by a reduction in the available space for the passage of blood vessels and nerves. Pain associated with such stenosis can be relieved by medication and/or surgery. Of course, it is desirable to eliminate the need for major  
20 surgery for all individuals and in particular for the elderly.

Accordingly, there needs to be developed procedures and implants for alleviating such condition which are minimally invasive, can be tolerated by the elderly and can be performed preferably on an outpatient basis.

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### Summary of the Invention:

The present invention is directed to providing a minimally invasive implant and method for alleviating discomfort associated with the spinal column.

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The present invention provides for apparatus and method for relieving pain by relieving the pressure and restrictions on the aforementioned blood vessels and nerves. Such alleviation of pressure is accomplished in the present invention through the use of an implant and method which distract the spinous process of adjacent vertebra in order to alleviate the problems caused by spinal stenosis and facet arthropathy and the like. While the implant and method particularly address the needs of the elderly, the invention can be used with individuals of all ages and sizes where distraction of the spinous process would be beneficial.

In one aspect of the invention, an implant is provided for relieving pain comprising a device positioned between a first spinous process and a second spinous process. The device includes a spinal column extension stop and a spinal column flexion non-inhibitor.

In another aspect of the invention, the implant is positioned between the first spinous process and the second spinous process and includes a distraction wedge that can distract the first and second spinous processes as the implant is positioned between the spinous processes.

In yet another aspect of the present invention, the implant includes a device which is adapted to increasing the volume of the spinal canal and/or the neural foramen as the device is positioned between adjacent spinous processes.

In yet a further aspect of the present invention, a method is presented for relieving pain due to the development of, by way of example only, spinal stenosis and facet arthropathy. The method is comprised of the steps of accessing adjacent first and second spinal processes of the spinal column and distracting the processes a sufficient amount in order to increase the volume of the spinal canal in order to relieve pain. The method further includes implanting a

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device in order to maintain the amount of distraction required to relieve such pain.

In yet a further aspect of the invention, the method includes implanting a device in order to achieve the desired distraction and to maintain that distraction.

In yet a further aspect of the invention, the implant includes a first portion and a second portion. The portions are urged together in order to achieve the desired distraction.

In still a further aspect of the invention, the implant includes a distracting unit and a retaining unit. The distracting unit includes a body which can be urged between adjacent spinous processes. The body includes a slot. After the distracting unit is positioned, the retaining unit can fit into the slot of the retaining unit and be secured thereto.

Other implants and methods within the spirit and scope of the invention can be used to increase the volume of the spinal canal thereby alleviating restrictions on vessels and nerves associated therewith, and pain.

#### **Brief Description of the Figures**

Figs. 1 and 2 depict an embodiment of an implant of the invention which is adjustable in order to select the amount of distraction required. Fig. 1 depicts the implant in a more extended configuration than does Fig. 2.

Figs. 3a and 3b depict side and end views of a first forked and of the embodiment of Fig. 1.

Figs. 4a and 4b depict side sectioned and end views of an interbody piece of the implant of Fig. 1.

Figs. 5a and 5b depict side and end views of a second forked end of the embodiment of Fig. 1.

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Figs. 6, 7, 8, 9 and 10 depict apparatus and method for another embodiment of the present invention for creating distraction between adjacent spinous processes.

5 Figs. 11, 12 and 13 depict yet a further embodiment of the invention for creating distraction between adjacent spinous processes.

Figs. 14 and 15 depict a further apparatus and method of an embodiment of the invention for creating distraction.

Figs. 16, 16a, and 17 depict yet another embodiment of the present invention.

10 Figs. 18, 19 and 20 depict yet a further apparatus and method of the present embodiment.

Figs. 21 and 22 depict still a further embodiment of the present invention.

15 Figs. 23, 24 and 25 depict another embodiment of the present invention.

Figs. 26, 27 and 28 depict another embodiment of the invention.

Figs. 29 and 30 depict side elevational views of differently shaped implants of embodiments of the present invention.

20 Figs. 31, 32 and 33 depict various implant positions of an apparatus of the present invention.

Figs. 34 and 35 depict yet another apparatus and method of the present invention.

25 Figs. 36, 37 and 38 depict three different embodiments of the present invention.

Figs. 39 and 40 depict yet another apparatus and method of an embodiment of the present invention.

Figs. 41, 42 and 43 depict yet further embodiments of an apparatus and method of the present invention.

Fig. 44 is still a further embodiment of an implant of the invention.

Fig. 45 is yet another depiction of an apparatus and method of the invention.

5 Figs. 46 and 47 depict still a further apparatus and method of an embodiment of the invention.

Figs. 48, 49, 50 and 51 depict yet a further apparatus and method of the invention.

10 Figs. 52, 53, 54, 55a and 55b depict another apparatus and method of the invention.

Figs. 56, 57 and 58 depict yet a further apparatus and method of the invention.

Figs. 59 and 60 depict still a further embodiment of the invention.

15 Fig. 61 depict another embodiment of the invention.

Figs. 62 and 63 depict yet another embodiment of the present invention.

Figs. 64 and 65 depict still a further embodiment of the present invention.

20 Fig. 66 depicts another embodiment of the invention.

Figs. 67 and 68 depict yet another embodiment of the present invention.

Figs. 69, 70, 71 and 71a depict a further embodiment of the present invention.

25 Figs. 72 and 73 depict still another embodiment of the invention.

Figs. 74, 75, 76, 77, and 78 depict still other embodiments of the invention.

30 Figs. 79, 80, 80a, 81, 82, 83, 83a, 84, 85, 86 and 87 depict still a further embodiment of the present invention.

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Figs. 88, 89, 90 and 91 depict yet another embodiment of the present invention.

### Detailed Description of the Preferred Embodiment

#### 5           Embodiment of Figs. 1-5a, 5b

A first embodiment of the invention is shown in Figs. 1-5a, 5b. *Channel*  
Implant 20 includes first and second forked ends 22 and 24, each defining a saddle 26, 28 respectively. The forked ends 22, 24 are mated using an interbody piece 30. As can be seen in Figs. 3a, 3b, 10 the first forked end 22 includes a threaded shaft 32 which projects rearwardly from the saddle 26. The threaded shaft 32 fits into the threaded bore 34 (Fig. 4a) of the interbody piece 30.

The second forked end 24 (Figs. 5a, 5b) includes a smooth cylindrical shaft 36 which can fit into the smooth bore 38 of the 15 interbody piece 30.

Fig. 1 shows the implant 20 in a fully extended position, while Fig. 2 shows the implant in an unextended position. In the unextended position, it can be seen that the threaded shaft 32 of the first forked end 22 fits inside the hollow cylindrical shaft 36 of the second forked end 24. 20

For purposes of implantation between adjacent first and second spinous processes of the spinal column, the implant 20 is configured as shown in Fig. 2. The first and second spinous processes are exposed using appropriate surgical techniques and thereafter, the 25 implant 20 is positioned so that saddle 26 engages the first spinous process, and saddle 28 engages the second spinous process. At this point, the interbody piece 30 can be rotated by placing an appropriate tool or pin into the cross holes 40 and upon rotation, the saddle 26 is moved relative to the saddle 28. Such rotation spreads apart or 30 distracts the spinous processes with the resultant and beneficial effect

of enlarging the volume of the spinal canal in order to alleviate any restrictions on blood vessels and nerves.

It is noted that this implant as well as the several other implants described herein act as an extension stop. That means that as the back is bent backwardly and thereby placed in extension the spacing between adjacent spinous processes cannot be reduced to a distance less than the distance between the lowest point of saddle 26 and the lowest point of saddle 28. This implant, however, does not inhibit or in any way limit the flexion of the spinal column, wherein the spinal column is bent forward.

Preferably, such a device provides for distraction in the range of about 5mm to about 15mm. However, devices which can distract up to and above 22mm may be used depending on the characteristics of the individual patient.

With all the ligaments (such as the superspinous ligament) and tissues associated with the spinous processes left intact, the implant 20 can be implanted essentially floating in position in order to gain the benefits of the aforementioned extension stop and flexion non-inhibitor. If desired, one of the saddles 26 can be laterally pinned with pin 29 to one of the spinous processes and the other saddle can be loosely associated with the other spinous processes by using a tether 31 which either pierces or surrounds the other spinous process and then is attached to the saddle in order to position the saddle relative to the spinous process. Alternatively, both saddles can be loosely tethered to the adjacent spinous process in order to allow the saddles to move relative to the spinous processes.

The shape of the saddles, being concave, gives the advantage of distributing the forces between the saddle and the respective spinous process. This ensures that the bone is not resorbed due to the

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placement of the implant 20 and that the structural integrity of the bone is maintained.

The implant 20 in this embodiment can be made of a number of materials, including but not limited to, stainless steel, titanium,  
5 ceramics, plastics, elastics, composite materials or any combination of the above. In addition, the modulus of elasticity of the implant can be matched to that of bone, so that the implant 20 is not too rigid. The flexibility of the implant can further be enhanced by providing additional apertures or perforations throughout the implant in addition  
10 to the holes 40 which also have the above stated purpose of allowing the interbody piece 30 to be rotated in order to expand the distance between the saddle 26, 28.

In the present embodiment, it is understood that the spinous processes can be accessed and distracted initially using appropriate  
15 instrumentation, and that the implant 20 can be inserted and adjusted in order to maintain and achieve the desired distraction. Alternatively, the spinous process can be accessed and the implant 20 appropriately positioned. Once positioned, the length of the implant can be adjusted in order to distract the spinous processes or extend the distraction of  
20 already distracted spinous processes. Thus, the implant can be used to create a distraction or to maintain a distraction which has already been created.

The placement of implants such as implant 20 relative to the spinous process will be discussed hereinbelow with other  
25 embodiments. However, it is to be noted that ideally, the implant 20 would be placed close to the instantaneous axis of rotation of the spinal column so that the forces placed on the implant 20 and the forces that the implant 20 places on the spinal column are minimized.

Further, it is noted that during the actual process of installing or  
30 implanting the implant 20, that the method uses the approach of

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extending the length of the implant 20 a first amount and then allowing the spine to creep or adjust to this distraction. Thereafter, implant 20 would be lengthened another amount, followed by a period where the spine is allowed to creep or adjust to this new level of distraction. This process could be repeated until the desired amount of distraction has been accomplished. This same method can be used with insertion tools prior to the installation of an implant. The tools can be used to obtain the desired distraction using a series of spinal distraction and spine creep periods before an implant is installed.

#### **Embodiment of Figs. 6, 7, 8, 9 and 10**

The embodiment of the invention shown in the above Figs. 6, 7, 8, 9 and 10 includes distraction or spreader tool 50 which has first and second arms 52, 54. Arms 52, 54 are pivotal about pivot point 56 and releaseable from pivot point 56 in order to effect the implantation of implant 58. As can be seen in Fig. 6, in cross-section, the arms 52, 54 are somewhat concave in order to cradle and securely hold the first spinous process 60 relative to arm 52 and the second spinous process 62 relative to arm 54. The distraction tool 50 can be inserted through a small incision in the back of the patient in order to address the space between the first spinous process 60 and the second spinous process 62. Once the tool 50 is appropriately positioned, the arms 52, 54 can be spread apart in order to distract the spinous processes. After this has occurred, an implant 58 as shown in Figs. 8 and 9, or of a design shown in other of the embodiments of this invention, can be urged between the arms 52, 54 and into position between the spinous processes. After this occurs, the arms 52, 54 can be withdrawn from the spinous processes leaving the implant 58 in place. The implant 58 is urged into place using a tool 64 which can be secured to the implant 58 through a threaded

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bore 66 in the back of the implant. As can be seen in Fig. 10, the implant 58 includes saddles 68 and 70 which cradle the upper and lower spinous processes 60, 62 in much the same manner as the above first embodiment and also in much the same manner as the individual arms of the tool 50. The saddles as described above tend to distribute the load between the implant and the spinous processes and also assure that the spinous process is stably seated at the lowest point of the respective saddles.

10                   **Embodiment of Figs. 11, 12 and 13**

Another embodiment of the apparatus and method of the invention is shown in Figs. 11, 12 and 13. In this embodiment, the spreader or distraction tool 80 includes first and second arms 82, 84 which are permanently pivoted at pivot point 86. The arms include L-shaped ends 88, 90. Through a small incision, the L-shaped ends 88, 90 can be inserted between the first and second spinous processes 92, 94. Once positioned, the arms 82, 84 can be spread apart in order to distract the spinous processes. The implant 96 can then be urged between the spinous processes in order to maintain the distraction. It is noted that implant 96 includes wedged surfaces or ramps 98, 100. As the implant 96 is being urged between the spinous processes, the ramps further cause the spinous processes to be distracted. Once the implant 96 is fully implanted, the full distraction is maintained by the planar surfaces 99, 101 located rearwardly of the ramps. It is to be understood that the cross-section of the implant 96 can be similar to that shown for implant 58 or similar to other implants in order to gain the advantages of load distribution and stability.

**Embodiments of Figs. 14, 15, 16, 16a, and 17**

In Figs. 14 and 15, yet another embodiment of the invention is depicted. In this embodiment, the implant 110 includes first and second conically shaped members 112, 114. Member 112 includes a male snap connector 116 and member 114 includes a female snap connector 118. With male snap connector 116 urged into female snap connector 118, the first member 112 is locked to the second member 114. In this embodiment, a distractor or spreader tool 80 could be used. Once the spinous process has been spread apart, an implantation tool 120 can be used to position and snap together the implant 110. The first member 112 of implant 110 is mounted on one arm and second member 114 is mounted on the other arm of tool 120. The member 112, 114 are placed on opposite sides of the space between adjacent spinous processes. The members 112, 114 are urged together so that the implant 110 is locked in place between the spinous processes as shown in Fig. 15. It is to be noted that the implant 110 can also be made more self-distracting by causing the cylindrical surface 122 to be more conical, much as surface 124 is conical, in order to hold implant 110 in place relative to the spinous processes and also to create additional distraction.

An alternative embodiment of the implant can be seen in Figs. 16 and 17. This implant 130 includes first and second members 132, 134. In this particular embodiment, the implants are held together using a screw (not shown) which is inserted through countersunk bore 136 and engages a threaded bore 138 of the second member 134. Surfaces 139 are flattened (Fig. 17) in order to carry and spread the load applied thereto by the spinous processes.

The embodiment of implant 130 is not circular in overall outside appearance, as is the embodiment 110 of Figs. 14 and 15. In particular, with respect to the embodiment of implant 130 of Figs. 16

and 17, this embodiment is truncated so that the lateral side 140, 142 are flattened with the upper and lower sides 144, 146 being elongated in order to capture and create a saddle for the upper and lower spinous processes. The upper and lower sides, 144, 146 are rounded to provide a more anatomical implant which is compatible with the spinous processes.

If it is desired, and in order to assure that the first member 132 and the second member 134 are aligned, key 148 and keyway 150 are designed to mate in a particular manner. Key 148 includes at least one flattened surface, such as flattened surface 152, which mates to an appropriately flattened surface 154 of the keyway 150. In this manner, the first member is appropriately mated to the second member in order to form appropriate upper and lower saddles holding the implant 130 relative to the upper and lower spinous processes.

Fig. 16a depicts second member 134 in combination with a rounded nose lead-in plug 135. Lead-in plug 135 includes a bore 137 which can fit snugly over key 148. In this configuration, the lead-in plug 135 can be used to assist in the placement of the second member 134 between spinous processes. Once the second member 134 is appropriately positioned, the lead-in plug 135 can be removed. It is to be understood that the lead-in plug 135 can have other shapes such as pyramids and cones to assist in urging apart the spinous processes and soft tissues in order to position the second member 134.

#### Embodiment of Figs. 18, 19 and 20

The implant 330 as shown in Fig. 18 is comprised of first and second mating wedges 332 and 334. In order to implant these wedges 332, 334, the spinous processes are accessed from both sides and then a tool is used to push the wedges towards each other. As the wedges are urged towards each other, the wedges move relative

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to each other so that the combined dimension of the implant 330 located between the upper and lower spinous processes 336, 338 (Fig. 20), increases, thereby distracting the spinous processes. It is noted that the wedges 332, 334 include saddle 340, 342, which  
5 receiving the spinous processes 336, 338. These saddles have the advantages as described hereinabove.

The first or second wedges 332, 334 have a mating arrangement which includes a channel 344 and a projection of 346 which can be urged into the channel in order to lock the wedges 332,  
10 334 together. The channel 334 is undercut in order to keep the projection from separating therefrom. Further, as in other devices described herein, a detent can be located in one of the channel and the projection, with a complimentary recess in the other of the channel and the projection. Once these two snap together, the wedges are  
15 prevented from sliding relative to the other in the channel 344.

While the above embodiment was described with respect to wedges, the wedges could also have been designed substantially as cones with all the same features and advantages.

#### 20 Embodiments of Figs. 21 and 22

The implant 370 is comprised of first and second distraction cone 372, 374. These cones are made of a flexible material. The cones are positioned on either side of the spinous processes 376, 378 as shown in Fig. 21. Using appropriate tool as shown hereinabove,  
25 the distraction cones 372, 374 are urged together. As they are urged together, the cones distract the spinous processes as shown in Fig. 22. Once this has occurred, an appropriate screw or other type of fastening mechanism 380 can be used to maintain the position of the distraction cones 372, 374. The advantage of this arrangement is that

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the implant 370 is self-distracting and also that the implant, being flexible, molds about the spinous processes as shown in Fig. 22.

**Embodiments of Fig. 23, 24 and 25**

5 In Figs. 23 and 24, another embodiment of the implant 170 is depicted. This implant is guided in place using an L-shaped guide 172 which can have a concave cross-section such as the cross-section 52 of retraction tool 50 in Fig. 6 in order to cradle and guide the implant 170 in position. Preferably a small incision would be made into the  
10 back of the patient and the L-shaped guide tool 172 inserted between the adjacent spinous processes. The implant 170 would be mounted on the end of insertion tool 174 and urged into position between the spinous processes. The act of urging the implant into position could cause the spinous processes to be further distracted if that is required.  
15 Prior to the insertion of the L-shaped guide tool 172, a distraction tool such as shown in Fig. 13 could be used to initially distract the spinous processes.

Implant 170 can be made of a deformable material so that it can be urged into place and so that it can somewhat conform to the shape  
20 of the upper and lower spinous processes. This deformable material would be preferably an elastic material. The advantage of such a material would be that the load forces between the implant and the spinous processes would be distributed over a much broader surface area. Further, the implant would mold itself to an irregular spinous  
25 process shape in order to locate the implant relative to spinous processes.

With respect to Fig. 25, this implant 176 can be inserted over a guide wire, guide tool or stylet 178. Initially, the guide wire 178 is positioned through a small incision to the back of the patient to a  
30 position between the adjacent spinous processes. After this has

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occurred, the implant is threaded over the guide wire 178 and urged into position between the spinous processes. This urging can further distract the spinous processes if further distraction is required. Once the implant is in place, the guide tool 178 is removed and the incision closed. The insertion tools of Figs. 23 and 24 can also be used if desired.

#### **Embodiment of Figs. 26, 27 and 28**

The embodiment shown in Figs. 26, 27 and 28 uses an implant similar to that depicted in Figs. 8 and 9 with different insertion tools. As can be seen in Fig. 26, an L-shaped distraction tool 190 is similar to L-shaped distraction tool 80 (Fig. 12), is used to distract the first and second spinous processes 192, 194. After this has occurred, an insertion tool 196 is placed between the spinous processes 192, 194. Insertion tool 196 includes a handle 198 to which is mounted a square-shaped ring 200.

The distraction tool 190 can be inserted through a small incision in the back in order to spread apart the spinous processes. Through the same incision which has been slightly enlarged laterally, an upper end 202 of ring 200 can be initially inserted followed by the remainder of the ring 200. Once the ring is inserted, the ring can be rotated slightly by moving handle 198 downwardly in order to further wedge the spinous processes apart. Once this has been accomplished, an implant such as implant 204 can be inserted through the ring and properly positioned using implant handle 206. Thereafter, the implant handle 206 and the insertion tool 196 can be removed.

#### **Embodiments of Figs. 29, 30, 31, 32 and 33**

As can be seen in Figs. 29 and 30, the implants 210, 212, can have different shapes when viewed from the side. These implants are

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similar to the above-referenced implants 58 (Fig. 8) and 204 (Fig. 28). These implants have cross-sections similar to that shown in Fig. 10 which includes saddles in order to receive and hold the adjacent spinous processes.

5           As can be seen in Figs. 31, 32 and 33, these implants can be placed in different positions with respect to the spinous process 214. Preferably as shown in Fig. 33, the implant 210 is placed closest to the lamina 216. Being so positioned, the implant 210 is close to the instantaneous axis of rotation 218 of the spinal column, and the  
10       implant would experience least forces caused by movement of the spine. Thus, theoretically, this is the optimal location for the implant.

          As can be seen in Figs. 31 and 32, the implant can be placed midway along the spinous process (Fig. 32) and towards the posterior aspect of the spinous process (Fig. 31). As positioned shown in Fig.  
15       31, the greatest force would be placed on the implant 210 due to a combination of compression and extension of the spinal column.

#### **Embodiment of Figs. 34 and 35**

          Another embodiment of the invention is shown in Figs. 34 and  
20       35. In these figures, implant 220 is comprised of a plurality of individual leaves 222 which are substantially V-shaped. The leaves include interlocking indentations or detents 224. That is, each leaf includes an indentation with a corresponding protrusion such that a protrusion of one leaf mates with an indentation of an adjacent leaf.  
25       Also associated with this embodiment is an insertion tool 226 which has a blunt end 228 which conforms to the shape of an individual leaf 222. For insertion of this implant into the space between the spinous processes as shown in Fig. 29, the insertion tool 226 first insert a single leaf 220. After that has occurred, the insertion tool then inserts  
30       a second leaf with the protrusion 224 of the second leaf snapping into

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corresponding indentation made by the protrusion 224 of the first leaf. This process would reoccur with third and subsequent leaves until the appropriate spacing between the spinous processes was built up. As can be seen in Fig. 29, the lateral edges 229 of the individual leaves  
5 222 are slightly curved upwardly in order to form a saddle for receiving the upper and lower spinous processes.

**Embodiments of Figs. 36, 37 and 38**

The embodiments of Figs. 36, 37 and 38 which include implants  
10 230, 232, and 234 respectively, are designed in such a manner so the implant locks itself into position once it is properly positioned between the spinous processes. Implant 220 is essentially a series of truncated cones and includes a plurality of ever expanding steps 236. These steps are formed by the conical bodies starting with the nose body  
15 238 followed there behind by conical body 240. Essentially, the implant 234 looks like a fir tree placed on its side.

The implant 230 is inserted laterally throughout the opening between upper and lower spinous processes. The first body 238 causes the initial distraction. Each successive conical body distracts  
20 the spinous processes a further incremental amount. When the desired distraction has been reached, the spinous processes are locked into position by steps 236. At this point, if desired, the initial nose body 238 of the implant and other bodies 240 can be broken, snapped or sawed off if desired in order to minimize the size of the implant 230.  
25 In order for a portion of the implant 230 to be broken or snapped off, the intersection between bodies such as body 238 and 240, which is intersection line 242, would be somewhat weakened with the appropriate removal of material. It is noted that only the intersection lines of the initial conical bodies need to be so weakened. Thus, intersection line  
30 244 between the bodies which remain between the spinous processes

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would not need to be weaker, as there would be no intention that the implant would be broken off at this point.

Fig. 37 shows implant 232 positioned between upper and lower spinous processes. This implant is wedge-shaped or triangular shaped in cross-sectioned and includes bore pluralities 245 and 246. Through these bores can be placed locking pins 248 and 250. The triangular or wedged-shaped implant can be urged laterally between and thus distract the upper and lower spinous processes. Once the appropriate distraction is reached, pins 248, 250 can be inserted through the appropriate bores of the bore pluralities 245 and 246 in order to lock the spinous processes in a V-shaped valley formed by pins 248, 250 on the one hand and the ramped surface 233, 235 on the other hand.

Turning to Fig. 38, the implant 234 has a triangular-shaped or wedge-shaped body similar to that shown in Fig. 32. In this embodiment, tab 252, 254 are pivotally mounted to the triangular shaped body 234. Once the implant 234 is appropriately positioned in order to distract the spinous processes to the desired amount, the tabs 252, 254 rotate into position in order to hold the implant 234 in the appropriate position.

20

#### **Embodiment of Figs. 39 and 40**

In the embodiment of Figs. 39 and 40, cannula 258 is inserted through a small incision to a position between upper and lower spinous processes. Once the cannula is properly inserted, an implant 260 is pushed through the cannula 258 using an insertion tool 262. The implant 260 includes a plurality of ribs or indentation 264 that assist in positioning the implant 260 relative to the upper and lower spinal processes. Once the implant 260 is in position, the cannula 258 is withdrawn so that the implant 260 comes in contact with and wedges between the spinous processes. The cannula 258 is somewhat conical

30

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in shape with the nose end 266 being somewhat smaller than the distal end 268 in order to effect the insertion of the cannula into the space between the spinous processes.

Further, a plurality of cannula can be used instead of one, with  
5 each cannula being slightly bigger than one before. In the method of the invention, the first smaller cannula would be inserted followed by successively larger cannula being placed over the previous smaller cannula. The smaller cannula would then be withdrawn from the center of the larger cannula. Once the largest cannula is in place, and  
10 the opening of the skin accordingly expanded, the implant, which is accommodated by only the larger cannula, is inserted through the larger cannula and into position.

#### **Embodiments of Figs. 41, 42 and 43**

15 The precurved implant 270 in Figs. 41 and 42, and precurved implant 272 in Fig. 43 have common introduction techniques which includes a guide wire, guide tool, or stylet 274. For both embodiments, the guide wire 274 is appropriately positioned through the skin of the patient and into the space between the spinous  
20 processes. After this is accomplished, the implant is directed over the guide wire and into position between the spinous processes. The precurved nature of the implant assist in (1) positioning the implant through a first small incision in the patient's skin on one side of the space between two spinous processes and (2) guiding the implant  
25 toward a second small incision in the patient's skin on the other side of the space between the two spinous processes. With respect to the implant 270, the implant includes a conical introduction nose 276 and a distal portion 278. As the nose 276 is inserted between the spinous processes, this causes distraction of the spinous processes. Break  
30 lines 280, 282 are established at opposite sides of the implant 270.

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Once the implant is properly positioned over the guide wire between the spinous processes, the nose portion 276 and the distal portion 278 can be broken off along the break lines, through the above two incisions, in order to leave the implant 270 in position.

5           Although only two break lines 280, 282 are depicted, multiple break lines can be provided on implant 270 so that the implant can continue to be fed over the guide wire 278 until the appropriate width of the implant 270 creates the desired amount of distraction. As described hereinabove, the break lines can be created by perforating  
10           or otherwise weakening the implant 270 so that the appropriate portions can be snapped or sawed off.

          With respect to the precurved implant 272, this implant is similar in design to the implant 230 shown in Fig. 36. This implant 272 in Fig. 47, however, is precurved and inserted over a guide wire 274 to  
15           a position between the spinous processes. As with implant 230 in Fig. 43, once the appropriate level of this distraction has been reached and if desired, sections of the implant 272 can be broken, snapped or sawed off as described hereinabove in order to leave a portion of the implant wedged between the upper and lower spinous processes.

20

#### **Embodiment of Fig. 44**

          A further embodiment of the invention is shown in Fig. 44. This embodiment includes a combination insertion tool and implant 290. The insertion tool and implant 290 is in the shape of a ring which is  
25           hinged at point 292. The ring is formed by a first elongated and conically shaped member 294 and a second elongated and conically shaped member 296. Members 294 and 296 terminate in points and through the use of hinge 292 are aligned and meet. Through similar incisions on both sides of the spinous processes, first member and  
30           second member are inserted through the skins of the patient and are

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5 mated together between the spinous processes. After this has occurred, the implant 290 is rotated, for example clockwise, so that increasingly widening portions of the first member 292 are used to distract the first and second spinous processes. When the appropriate level of distraction has occurred, the remainder of the ring before and after the section which is located between the spinous processes can be broken off as taught hereinabove in order to maintain the desired distraction. Alternatively, with a small enough ring, the entire ring can be left in place with the spinous processes distracted.

#### Embodiment of Fig. 45

10 In Fig. 45, the implant 300 is comprised of a plurality of rods or stylets 302 which are inserted between the upper and lower spinous processes. The rods are designed much as described hereinabove so that they may be broken, snapped or cut off. Once these are inserted and the appropriate distraction has been reached, the stylets are broken off and a segment of each stylet remains in order to maintain distraction of the spinous process.

#### Embodiment of Figs. 46 and 47

20 Implant 310 of Figs. 46 and 47 is comprised of a shape memory material which coils upon being released. The material is straightened out in a delivery tool 312. The delivery tool is in position between upper and lower spinous processes 314, 316. The material is then pushed through the delivery tool. As it is released from the delivery end 318 of the delivery tool, the material coils, distracting the spinous processes to the desired amount. Once this distraction has been achieved, the material is cut and the delivery tool removed.

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**Embodiments of Figs. 48, 49, 50 and 51**

As can be seen in Fig. 48, the implant 320 is delivered between upper and lower spinous processes 322 and 324, by delivery tool 326. Once the implant 320 is in place between the spinous processes, the delivery tool is given a 90° twist so that the implant goes from the orientation as shown in Fig. 49, with longest dimension substantially perpendicular to the spinous processes, to the orientation shown in Fig. 50 where the longest dimension is in line with and parallel to the spinous processes. This rotation causes the desired distraction between the spinous processes. Implant 320 includes opposed recesses 321 and 323 located at the ends thereof. Rotation of the implant 320 causes the spinous processes to become lodged in these recesses.

Alternatively, the insertion tool 326 can be used to insert multiple implants 320, 321 into the space between the spinous processes 322, 324 (Fig. 51). Multiple implants 320, 321 can be inserted until the appropriate amount of distraction is built up. It is to be understood in this situation that one implant would lock to another implant by use of, for example, a channel arrangement wherein a projection from one of the implants would be received into and locked into a channel of the other implant. Such a channel arrangement is depicted with respect to the other embodiment.

**Embodiment of Figs. 52, 53, 54, 55a and 55b**

The embodiment of Figs. 52 through 55b is comprised of a fluid-filled dynamic distraction implant 350. This implant includes a membrane 352 which is placed over pre-bent insertion rod 354 and then inserted through an incision on one side of the spinous process 356. The bent insertion rod, with the implant 350 thereover, is guided between appropriate spinous processes. After this occurs, the

insertion rod 354 is removed leaving the flexible implant in place. The implant 350 is then connected to a source of fluid (gas, liquid, gel and the like) and the fluid is forced into the implant causing it to expand as shown in Fig. 54, distracting the spinal processes to the desired amount. Once the desired amount of distraction has occurred, the implant 350 is closed off as is shown in Fig. 55a. The implant 350 being flexible, can mold to the spinous processes which may be of irregular shape, thus assuring positioning. Further, implant 350 acts as a shock absorber, damping forces and stresses between the implant and the spinous processes.

A variety of materials can be used to make the implant and the fluid which is forced into the implant. By way of example only, viscoelastic substances such as methylcellulose, or hyaluronic acid can be used to fill the implant. Further, materials which are initially a fluid, but later solidify, can be inserted in order to cause the necessary distraction. As the materials solidify, they mold into a custom shape about the spinous processes and accordingly are held in position at least with respect to one of two adjacent spinous processes. Thus, it can be appreciated that using this embodiment and appropriate insertion tools the implant can be formed about one spinous process in such a manner that the implant stays positioned with respect to that spinous process (Fig. 55b). With such an embodiment, a single implant can be used as an extension stop for spinous process located on either side, without restricting flexion of the spinal column.

It is to be understood that many of the other implants disclosed herein can be modified so that they receive a fluid in order to establish and maintain a desired distraction much in the manner as implant 350 receives a fluid.

**Embodiment of Figs. 56, 57 and 58**

The implant 360 as shown in Fig. 56 is comprised of a shape memory material such as a plastic or a metal. A curved introductory tool 362 is positioned between the appropriate spinous processes as described hereinabove. Once this has occurred, bore 364 of the implant is received over the tool. This act can cause the implant to straighten out. The implant is then urged into position and thereby distracts the spinous processes. When this has occurred, the insertion tool 362 is removed, allowing the implant to assume its pre-straightened configuration and is thereby secured about one of the spinous processes. Such an arrangement allows for an implant that is an extension stop and does not inhibit flexion of the spinous column. Alternatively, the implant can be temperature sensitive. That is to say that the implant would be more straightened initially, but become more curved when it was warmed by the temperature of the patient's body.

**Embodiments of Figs. 59 and 60**

In this embodiment, the implant 380 is comprised of a plurality of interlocking leaves 382. Initially, a first leaf is positioned between opposed spinous processes 384, 386. Then subsequently, leaves 382 are interposed between the spinous processes until the desired distraction has been built up. The leaves are somewhat spring-like in order to absorb the shock and can somewhat conform to the spinous processes.

**Embodiment of Fig. 61**

The implant 390 of Fig. 61 includes the placement of shields 392, 394 over adjacent spinous processes 396, 398. The shields are used to prevent damage to the spinous processes. These shields include apertures which receives a self-tapping screw 400, 402. In

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practice, the shields are affixed to the spinous processes and the spinous processes are distracted in the appropriate amount. Once this has occurred, a rod 404 is used to hold the distracted position by being screwed into each of the spinous processes through the aperture  
5 in the shields using the screws as depicted in Fig. 61.

#### **Embodiment of Figs. 62 and 63**

Implant 410 of Figs. 62, 63 is comprised of first and second members 412, 414 which can be mated together using an appropriate  
10 screw and threaded bore arrangement to form the implant 410. Main member 412 and mating member 414 form implant 410. Accordingly, the implant 410 would have a plurality of members 414 for use with a standardized first member 412. Figs. 62 and 64 show different types of mating members 414. In Fig. 62, the mating member 414  
15 includes projections 416 and 418 which act like shims. These projections are used to project into the space of saddles 420, 422 of the first member 412. These projections 416, 418 can be of varying lengths in order to accommodate different sizes of spinous processes. A groove 424 is placed between the projections 416, 418 and mates  
20 with an extension 426 of the first member 412.

As shown in Fig. 63, the projections of the embodiment shown in Fig. 62 are removed and recesses 428, 430 are substituted therefor. These recesses expand the area of the saddles 420, 422 in order to accommodate larger spinous processes.

25

#### **Embodiment of Figs. 64, 65 and 66**

The embodiments of Figs. 64, 65 and 66 are similar in design and concept to the embodiment of Figs. 62 and 63. In Fig. 64, the implant 500 includes the first and second members 502, 504. These  
30 members can be secured together with appropriate screws or other

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fastening means as taught in other embodiments. Implant 500 includes first and second saddles 506, 508 which are formed between the ends of first and second members 502, 504. These saddles 506, 508 are used to receive and cradle the adjacent spinous processes. As can be seen in Fig. 64, each saddle 506, 508 is defined by a single projection or leg 510, 512, which extends from the appropriate first and second members 502, 504. Unlike the embodiment found in Figs. 62 and 63, each of the saddles is defined by only a single leg as the ligaments and other tissues associated with the spinous processes can be used to ensure that the implant is held in an appropriate position. With the configuration of Fig. 64, it is easier to position the implant relative to the spinous processes as each saddle is defined by only a single leg and thus the first and second members can be more easily worked into position between the various tissues.

In the embodiment of Fig. 65, the implant 520 is comprised of a single piece having saddles 522 and 524. The saddles are defined by a single leg 526, 528 respectively. In order for this implant 520 to be positioned between the spinous processes, an incision is made between lateral sides of adjacent spinous processes. The single leg 526 is directed through the incision to a position adjacent to an opposite lateral side of the spinous process with the spinous process cradled in the saddle 522. The spinous processes are then urged apart until saddle 524 can be pivoted into position into engagement with the other spinous process in order to maintain the distraction between the two adjacent spinous processes.

The embodiment of Fig. 66 is similar to that of Fig. 65 with an implant 530 and first and second saddles 532 and 534. Associated with each saddle is a tether 536, 538 respectively. The tethers are made of flexible materials known in the trade and industry and are positioned through bores in the implant 530. Once appropriately

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positioned, the tethers can be tied off. It is to be understood that the tethers are not meant to be used to immobilize one spinous process relative to the other, but are used to guide motion of the spinous processes relative to each other so that the implant 530 can be used as an extension stop and a flexion non-inhibitor. In other words, the saddles 532, 534 are used to stop spinal column backward bending and extension. However, the tethers do not inhibit forward bending and spinal column flexion.

#### Embodiments of Figs. 67, 68

The implant 550 is Z-shaped and includes a central body 552 and first and second arms 554, 556, extending in opposite directions therefrom. The central body 552 of the implant 550 includes first and second saddles 558 and 560. The first and second saddles 558 and 560 would receive upper and lower spinous processes 562, 568. The arms 554, 556 are accordingly located adjacent the distal end 566 (Fig. 68) of the central body 552. The first and second arms 554, 556, act to inhibit forward movement, migration or slippage of the implant 550 toward the spinal canal and keep the implant in place relative to the first and second spinal processes. This prevents the implant from pressing down on the ligamentum flavum and the dura. In a preferred embodiment, the central body would have a height of about 10mm with each of the arms 554, 556 have a height of also about 10mm. Depending on the patient, the height of the body could vary from about less than 10mm to about greater than 24mm. As can be seen in Figs. 67 and 68, the first and second arms 554, 556 are additionally contoured in order to accept the upper and lower spinous processes 556, 558. In particular, the arms 554, 556 as can be seen with respect to arm 554 have a slightly outwardly bowed portion 568 (Fig. 68) with a distal end 570 which is slightly inwardly bowed. This

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configuration allows the arm to fit about the spinous process with the distal end 570 somewhat urged against the spinous process in order to guide the motion of the spinous process relative to the implant. These arms 554, 556 could if desired to be made more flexible than the central body 552 by making arms 554, 556 thin and/or with perforations, and/or other material different than that of the central body 550. As with the last embodiment, this embodiment can be urged into position between adjacent spinous processes by directing an arm into a lateral incision so that the central body 552 can be finally positioned between spinous processes.

#### **Embodiment of Figs. 69, 70, 71 and 71a**

Figs. 69, 70 and 71 are perspective front, end, and side views of implant 580 of the invention. This implant includes a central body 582 which has first and second saddles 584, 586 for receiving adjacent spinous processes. Additionally, the implant 580 includes first and second arms 588 and 590. The arms, as with the past embodiment, prevent forward migration or slippage of the implant toward the spinal canal. First arm 588 projects outwardly from the first saddle 584 and second arm 590 projects outwardly from the second saddle 586. In a preferred embodiment, the first arm 588 is located adjacent to the distal end 600 of the central body 582 and proceeds only partly along the length of the central body 582. The first arm 588 is substantially perpendicular to the central body as shown in Fig. 70. Further, the first arm 588, as well as the second arm 590, is anatomically rounded.

The second arm 590, projecting from second saddle 586, is located somewhat rearward of the distal end 600, and extends partially along the length of the central body 582. The second arm 590 projects at a compound angle from the central body 582. As can

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be seen in Figs. 70 and 71, the second arm 590 is shown to be at about an angle of 45° from the saddle 586 (Fig. 70). Additionally, the second arm 590 is at an angle of about 45° relative to the length of the central body 580 as shown in Fig. 71. It is to be understood that other compound angles are within the spirit and scope of the invention as claimed.

In a preferred embodiment, the first and second arms 588, 590 have a length which is about the same as the width of the central body 582. Preferably, the length of each arm is about 10mm and the width of the central body is about 10mm. However, the bodies with the widths of 24mm and greater are within the spirit and scope of the invention, along with first and second arms ranging from about 10mm to greater than about 24mm. Further, it is contemplated that the embodiment could include a central body having a width of about or greater than 24mm with arms being at about 10mm.

It is to be understood that the embodiment of Figs. 69, 70 and 71 as well as the embodiment of Figs. 67 and 68 are designed to preferably be positioned between the L4-L5 and the L5-S1 vertebral pairs. The embodiment of Figs. 69, 70, 71 is particularly designed for the L5-S1 position with the arms being designed to conform to the sloping surfaces found therebetween. The first and second arms are thus contoured so that they lie flat against the lamina of the vertebra which has a slight angle.

The embodiment of Fig. 69, 70, and 71 as with the embodiment of Figs. 67 and 68 is Z-shaped in configuration so that it may be inserted from one lateral side to a position between adjacent spinous processes. A first arm, followed by the central body, is guided through the space between the spinous processes. Such an arrangement only requires that a incision on one side of the spinous

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process be made in order to successfully implant the device between the two spinous processes.

The implant 610 of Fig. 71a is similar to that immediately above with the first arm 612 located on the same side of the implant as the second arm 614. The first and second saddle 616, 618 are slightly modified in that distal portion 620, 622 are somewhat flattened from the normal saddle shape in order to allow the implant to be positioned between the spinous processes from one side. Once in position, the ligaments and tissues associated with the spinous processes would hold the implant into position. Tethers also could be used if desired.

#### Embodiment of Figs. 72, 73

Implant 630 is also designed so that it can be inserted from one side of adjacent spinous processes. This insert 630 includes a central body 632 with the first and second arms 634, 636 extending on either side thereof. As can be seen in Fig. 72, a plunger 638 is positioned to extend from an end of the central body 632. As shown in Fig. 72, the plunger 638 is fully extended and as shown in Fig. 73, the plunger 638 is received within the central body 632 of the implant 630. With the plunger received into the implant 632, the third and fourth arms or hooks 640, 642 can extend outwardly from the central body 632. The third and fourth arms or hooks 640, 642 can be comprised of a variety of materials, such as for example, shape memory metal materials or materials which have a springy quality.

For purposes of positioning the implant 630 between adjacent spinous processes, the plunger 638 is pulled outwardly as shown in Fig. 72. The central body 632 is then positioned between adjacent spinous processes and the plunger 638 is allowed to move to the position of Fig. 73 so that the third and fourth arms 640, 642 can

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project outwardly from the central body 632 in order to hold the implant 630 in position between the spinous processes.

Plunger 638 can be spring biased to the position as shown in Fig. 73 or can include detents or other mechanisms which lock it into that position. Further, the third and fourth arms themselves, as deployed, can keep the plunger in the position as shown in Fig. 73.

**Embodiments of Figs. 74, 75, 76, 77, and 78**

Other embodiments of the invention are shown in Figs. 74 through 78. Figs. 74, 75 and 76 disclose implant 700. Implant 700 is particularly suited for implantation between the L4-L5 and L5-S1 vertebra. As can be seen in Fig. 74, the implant 700 includes a central body 702 which has a bore 704 provided therein. Bore 704 is used in order to adjust the modulus of elasticity of the implant so that it is preferably approximately two times the anatomical load placed on the vertebra in extension. In other words, the implant 700 is approximately two times stiffer than the normal load placed on the implant. Such an arrangement is made in order to ensure that the implant is somewhat flexible in order to reduce potential resorption of the bone adjacent to the implant. Other modulus values can be used and be within the spirit of the invention.

Implant 700 includes first and second saddle 706, 708 which are used to receive and spread the load from the upper and lower spinous processes. The saddle 706 is defined by first and second arms 710 and 712. The second saddle 708 is defined by third and fourth arms 714 and 716. As can be seen in Fig. 74, the first arm 710, in a preferred embodiment, is approximately two times the length of the body 702 with the second arm being approximately less than a quarter length of the body. Third arm 714 is approximately one times the length of the body 702 with the fourth arm 716 being, in this

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preferred embodiment, approximately one and a half times the length of the body 702. The arms are designed in such a way that the implant (1) can be easily and conveniently inserted between the adjacent spinous processes, (2) will not migrate forwardly toward the spinal canal, and (3) will hold its position through flexion and extension as well as lateral bending of the spinal column.

First arm 710 is in addition designed to accommodate the shape of the vertebra. As can be seen in Fig. 74, the first arm 710 becomes narrower as it extends away from the body 702. The first arm 710 includes a sloping portion 718 followed by a small recess 720 ending in a rounded portion 722 adjacent to the end 724. This design is provided to accommodate the anatomical form of for example the L4 vertebra. It is to be understood that these vertebra have a number of surfaces at roughly 30° angles and that the sloping surfaces of this embodiment and the embodiments shown in Figs. 77 and 78 are designed to accommodate these surfaces. These embodiments can be further modified in order to accommodate other angles and shapes.

The second arm 712 is small so that it is easy to insert between the spinous processes, yet still define the saddle 706. The fourth arm 716 is larger than the third arm 714, both of which are smaller than the first arm 710. The third and fourth arms are designed so that they define the saddle 706, guide the spinous processes relative to the implant 700 during movement of the spinal column, and yet are of a size which makes the implant easy to position between the spinous processes.

The procedure, by way of example only, for implanting the implant 700 can be to make an incision laterally between two spinous processes and then initially insert first arm 710 between the spinous processes. The implant and/or appropriate tools would be used to distract the spinous processes allowing the third leg 714 and the

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central body 702 to fit through the space between the spinous processes. The third leg 714 would then come to rest adjacent the lower spinous processes on the opposite side with the spinous processes resting in the first and second saddle 706, 708. The longer  
5 fourth leg 716 would then assist in the positioning of the implant 700.

Fig. 77 includes an implant 740 which is similar to implant 700 and thus have similar numbering. The saddle 706, 708 of implant 740 have been cantered or sloped in order to accommodate the bone structure between, by way of example, the L4-L5 and the L5-S1  
10 vertebra. As indicated above, the vertebra in this area have a number of sloping surfaces in the range of about 30°. Accordingly, saddle 706 is sloped at less than 30° and preferably about 20° while saddle 708 is sloped at about 30° and preferably more than 30°.

The implant 760 as shown in Fig. 78 is similar to implant 700  
15 in Fig. 74 and is similarly numbered. Implant 760 includes third and fourth legs 714, 716 which have sloping portions 762, 764 which slope toward ends 766, 768 of third and fourth arm 714, 716 respectively. The sloping portions accommodate the form of the lower vertebra against which they are positioned. In the preferred  
20 embodiment, the sloping portions are of about 30°. However, it is to be understood that sloping portions which are substantially greater and substantially less than 30° can be included and be within the spirit and scope of the invention.

25       Embodiment of Fig. 79, 80, 80a, 81, 82, 83, 83a, 84, 85, 86 and 87

Another embodiment of the invention is shown in Figs. 79-87 and includes implant 800 (Fig. 86). Implant 800 includes a distracting unit 802 which is shown in left side, plan, and right side views of Figs.  
30 79, 80 and 81. A perspective view of the distraction unit is shown in

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Fig. 84. The distracting unit as can be seen in Fig. 80 includes a distracting body 804, with longitudinal axis 805, which body 804 has a groove 806 and a rounded or bulbous end 808 which assist in the placement of the distracting body between adjacent spinous process so that an appropriate amount of distraction can be accomplished. Extending from the distracting body 804 is a first wing 810 which in Fig. 80 is substantially perpendicular to the distracting body 804. Such wings which are not perpendicular to the body are within the spirit and scope of the invention. First wing 810 includes an upper portion 812 and a lower portion 814. The upper portion 810 (Figs. 79) includes a rounded end 816 and a small recess 818. The rounded end 816 and the small recess 818 in the preferred embodiment are designed to accommodate the anatomical form or contour of the L4 (for a L4-L5 placement) or L5 (for a L5-S1 placement) superior lamina of the vertebra. It is to be understood that the same shape or variations of this shape can be used to accommodate other lamina of any vertebra. The lower portion 814 is also rounded in order to accommodate in the preferred embodiment in order to accommodate the vertebrae. The distracting unit further includes a threaded bore 820 which in this embodiment accepts a set screw 822 (Fig. 86) in order to hold a second wing 824 (Figs. 82, 83) in position as will be discussed hereinbelow.

The threaded bore 820 in this embodiment slopes at approximately 45° angle and intersects the slot 806. With the second wing 824 in position, the set screw 822 when it is positioned in the threaded bore 820 can engage and hold the second wing 824 in position in the slot 806.

Turning to Figs. 82, 83 and 85, left side, plan and perspective views of the second wing 824 are depicted. The second wing 824 is similar in design to the first wing. The second wing includes an upper

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portion 826 and a lower portion 828. The upper portion includes a rounded end 830 and a small recess 832. In addition, the second wing 824 includes a slot 834 which mates with the slot 806 of the distracting unit 802. The second wing 824 is the retaining unit of the present embodiment.

As can be seen in Fig. 83 and 86, the second wing or retaining unit 824 includes the upper portion 826 having a first width "a" and the lower portion 828 having a second width "b". In the preferred embodiment, the second width "b" is larger than first width "a" due to the anatomical form or contour of the L4-L5 or L5-S1 laminae. As can be seen in Fig. 83a in second wing or retaining unit 824, the widths "a" and "b" would be increased in order to, as described hereinbelow, accommodate spinous processes and other anatomical forms or contours which are of different dimensions. Further, as appropriate, width "a" can be larger than width "b". Thus, as will be described more fully hereinbelow, the implant can include a universally-shaped distracting unit 802 with a plurality of retaining units 824, with each of the retaining units having different widths "a" and "b". During surgery, the appropriately sized retaining unit 824, width with the appropriate dimensions "a" and "b" can be selected to match to the anatomical form of the patient.

Fig. 86 depicts an assembled implant 800 positioned adjacent to upper and lower laminae 836, 838 (which are shown in dotted lines) of the upper and lower vertebrae. The vertebrae 836, 838 are essentially below the implant 800 as shown in Fig. 86. Extending upwardly from the vertebrae 836, 838, and between the first and second wings 810, 824, are the upper and lower spinous processes 840, 842. It is to be understood that in a preferred embodiment, the fit of the implant between the spinous processes can be such that the

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wings do not touch the spinous processes, as shown in Fig. 86, and be within the spirit and scope of the invention.

The implant 800 includes, as assembled, an upper saddle 844 and the lower saddle 846. The upper saddle 844 has an upper width identified by the dimension "UW". The lower saddle 846 has a lower width identified by the dimension "LW". In a preferred embodiment, the upper width is greater than the lower width. In other embodiments, the "UW" can be smaller than the "LW" depending on the anatomical requirements. The height between the upper and lower saddles 844, 846 is identified by the letter "h". These dimensions are carried over into Fig. 87 which is a schematic representation of the substantially trapezoidal shape which is formed between the upper and lower saddles. The table below gives sets of dimensions for the upper width, lower width, and height as shown in Fig. 87. This table includes dimensions for some variations of this embodiment.

TABLE

Variation	1	2	3
Upper Width	8	7	6
Lower Width	7	6	5
Height	10	9	8

For the above table, all dimensions are given in millimeters.

For purposes of surgical implantation of the implant 800 into a patient, the patient is preferably positioned on his side (arrow 841 points up from an operating table) and placed in a flexed (tucked) position in order to distract the upper and lower vertebrae.

In a preferred procedure, a small incision is made on the midline of the spinous processes. The spinous processes are spread apart or distracted with a spreader. The incision is spread downwardly toward the table, and the distracting unit 802 is preferably inserted upwardly

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between the spinous processes 840 and 842 in a manner that maintains the distraction of spinous processes. The distracting unit 802 is urged upwardly until the distracting or bulbous end 808 and the slot 806 are visible on the other wide of the spinous process. Once this is visible, the incision is spread upwardly away from the table and the retaining unit or second wing 824 is inserted into the slot 806 and the screw 822 is used to secure the second wing in position. After this had occurred, the incisions can be closed.

An alternative surgical approach requires that small incisions be made on either side of the space located between the spinous processes. The spinous processes are spread apart or distracted using a spreader placed through the upper incision. From the lower incision, the distracting unit 802 is preferably inserted upwardly between the spinous processes 840 and 842 in a manner that urges the spinous processes apart. The distracting unit 802 is urged upwardly until the distracting or bulbous end 808 and the slot 806 are visible through the second small incision in the patient's back. Once this is visible, the retaining unit or second wing 824 is inserted into the slot 806 and the screw 822 is used to secure the second wing in position. After this has occurred, the incisions can be closed.

The advantage of either of the above present surgical procedures is that a surgeon is able to observe the entire operation, where he can look directly down onto the spinous processes as opposed to having to view the procedure from positions which are to the right and to the left of the spinous processes. Generally, the incision is as small as possible and the surgeon is working in a bloody and slippery environment. Thus, an implant that can be positioned directly in front of a surgeon is easier to insert and assemble than an implant which requires the surgeon to shift from side to side. Accordingly, a top-down approach, as an approach along a position to

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anterior line is preferred so that all aspects of the implantation procedure are fully visible to the surgeon at all times. This aides in the efficient location of (i) the distracting unit between the spinous processes, (ii) the retaining unit in the distracting unit, and (iii) finally the set screw in the distracting unit.

Fig. 80a shows an alternative embodiment of the distracting unit 802a. This distracting unit 802a is similar to distracting unit 802 in Fig. 80 with the exception that the bulbous end 808a is removable from the rest of the distracting body 804a as it is screwed into the threaded bore 809. The bulbous end 808a is removed once the distracting unit 802a is positioned in the patient in accordance with the description associated with Fig. 86. The bulbous end 808a can extend past the threaded bore 820 by about 1cm in a preferred embodiment.

#### Embodiment of Figs. 88, 89, 90 and 91

Another embodiment of the invention is shown in Figs. 88, 89, 90 and 91. In this embodiment, the implant is identified by the number 900. Other elements of implant 900 which are similar to implant 800 are similarly numbered but in the 900 series. For example, the distracting unit is identified by the number 902 and this is in parallel with the distracting unit 802 of the implant 800. The distracting body is identified by the number 904 in parallel with the distracting body 804 of the implant 800. Focusing on Fig. 90, the distracting unit 902 is depicted in a perspective view. The distracting unit includes slot 906 which is wider at the top than at the bottom. The reason for this is that the wider upper portion of the slot 906, which is wider than the second wing 924 (Fig. 89), is used to allow the surgeon to easily place the second wing 924 into the slot 906 and allow the wedge-shaped slot 906 to guide the second wing 924 to its final resting position. As can be see in Fig. 91, in the final resting

position, the largest portion of the slot 906 is not completely filled by the second wing 924.

5 The end 908 of implant 900 is different in that it is more pointed, having sides 909 and 911 which are provided at about 45° angles (other angles, such as by way of example only, from about 30° to about 60° are within the spirit of the invention), with a small flat tip 913 so that the body 904 can be more easily urged between the spinous processes.

10 The distracting unit 902 further includes a tongue-shaped recess 919 which extends from the slot 906. Located in the tongue-shaped recess is a threaded bore 920.

15 As can be seen in Fig. 89, a second wing 924 includes a tongue 948 which extends substantially perpendicular thereto and between the upper and lower portions 926, 928. The tab 948 includes a bore 950. With the second wing 924 positioned in the slot 906 of the distracting unit 902 and tab 948 positioned in recess 919, a threaded set screw 922 can be positioned through the bore 950 and engage the threaded bore 920 in order to secure the second wing or retaining unit 924 to the distracting unit 902. The embodiment 900 is implanted in  
20 the same manner as embodiment 800 previously described. In addition, as the bore 922 is substantially perpendicular to the distracting body 904 (and not provided at an acute angle thereto), the surgeon can even more easily secure the screw in place from a position directly behind the spinous processes.

25

#### **Industrial Applicability**

From the above, it is evident that the present invention can be used to relieve pain caused by spinal stenosis in the form of, by way of example only, central canal stenosis or foraminal (lateral) stenosis.  
30 These implants have the ability to flatten the natural curvature of the

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spine and open the neural foramen and the spacing between adjacent vertebra to relieve problems associated with the above-mentioned lateral and central stenosis. Additionally, the invention can be used to relieve pain associated with facet arthropathy. The present invention  
5 is minimally invasive and can be used on an outpatient basis.

Additional aspects, objects and advantages of the invention can be obtained through a review of the appendant claims and figures.

It is to be understood that other embodiments can be fabricated and come within the spirit and scope of the claims.

10

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We claim:

1. An implant for relieving pain associated with the spinal column comprising:

5 a device that is adapted to be positionable between a first spinous process and a second spinous process;

said device including a first means for not limiting flexion of the spinal column; and

10 said device including a second means for limiting extension of the spinal column.

2. The implant of claim 1 wherein:

said first means does not prevent the spreading apart of the first spinous process from the second spinous process; and

15 said second means does stop the motion of the first spinous process and the second spinous process to toward each other.

3. The implant of claim 1 wherein:

20 said device includes a spinous process containment member; and

said first means includes an open end of said spinous process containment member; and

said second means includes a saddle of said spinous process containment member.

25

4. The implant of claim 1 wherein:

said device includes a means for distracting the first spinous process from the second spinous process.

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5. The implant of claim 4 wherein:

said distraction means can create a distraction of at least about 5 mm upon insertion between the first and the second spinous process.

5

6. The implant of claim 4 wherein:

said distraction means can create a distraction of about 5 mm to about 15 mm upon insertion.

10

7. A spinal column implant comprising:

a device positionable between a first spinous process and a second spinous process;

said device including a spinal column extension stop; and

wherein said device does not inhibit spinal column flexion.

15

8. A spinal column implant comprising:

a device that is adapted to be positionable between a first spinous process and a second spinous process;

said device includes a spinal column extension stop; and

20

said device includes a spinal column flexion non-inhibitor.

9. The implant of claim 8 wherein:

said device is comprised of one of stainless steel, titanium, ceramic, a composite material, an elastic material, a polymer, and a plastic material..

25

10. An implant for relieving pain associated with the spinal column comprising:

a device that is adapted to be positionable between a first

30

spinous process and a second spinous process; and

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said device including means for distracting the first and the second spinous processes upon implant in order to relieve pain through distraction.

5           11.    The implant of claim 10 wherein:  
said distracting means causes distraction of at least about 5 mm  
between the first and the second spinous process.

10           12.    The implant of claim 10 wherein:  
said distracting means causes distraction of about 5 mm to  
about 15 mm.

15           13.    An implant for relieving pain associated with the spinal  
column comprising:  
a device that is adapted to be positionable between a first  
spinous process and a second spinous process; and  
said device including a distracting wedge that can distract the  
first and the second spinous processes.

20           14.    The implant of claim 13 wherein:  
said distraction wedge can distract the first and the second  
spinous processes by about 5 mm.

25           15.    The implant of claim 8 wherein;  
said spinal column extension stop is adjustable to fit the size of  
various spinous processes.

30           16.    The implant of claim 8 wherein:  
said spinal column extension stop is adapted to be associated  
with the first spinous process

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another spinal column extension stop adapted to be associated with the second spinous process, said spinal column extension stop spaced from the another spinal column extension stop; and

5 a length adjustor located between the spinal column extension stops in order to selectively adjust the distance between the extension stops.

17. The implant of claim 8 wherein:  
said device is positionable adjacent to the posterior aspects of  
10 the first and the second spinous processes.

18. The implant of claim 8 wherein:  
said device is positionable adjacent to the axis of rotation of the  
spinal column.

15 19. The implant of claim 8 wherein:  
said device is positionable adjacent to the lamina of the spinal column.

20 20. The implant of claim 8 wherein:  
said device is flexible in order to avoid bone resorption.

21. The implant of claim 8 wherein:  
said device is flexible.

25 22. The implant of claim 8 wherein:  
said device includes a first member and a second member and a fastener that can secure the first member to the second member; and

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with said first member fastened to said second member with said fastener, said fastened together first and second members define said extension stop and another extension stop.

5           23. The implant of claim 22 wherein:

said extension stop is spaced from said another extension stop; and with the device implanted in a spinal column the extension stop is associated with the first spinous process and the another extension stop is associated with the second spinous process.

10

24. The implant of claim 22 wherein:

said second member is selected from a plurality of differently sized second members that can accommodate variously sized spinous processes.

15

25. The implant of claim 22 wherein:

said fastener is part of either the first member or the second member.

20

26. An implant for relieving pain associated with the spinal column comprising:

a device that is adapted to be positionable between a first spinous process and a second spinous process; and

25           the device is adapted to increase the volume of a spinal canal and/or a neural foramen in said spinal column in association with the positioning of the device between the spinous processes.

27. The implant of claim 26 wherein:

30           the device inhibits any decrease in the volume of the spinal cord and/or neural foramen as the spinal column is placed in extension.

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28. The implant of claim 8 wherein:  
said device includes a shock absorber.

5 29. The implant of claim 13 wherein:  
said device includes a shock absorber.

30. The implant of claim 26 wherein:  
said device includes a shock absorber.

10 31. The implant of claim 8 wherein:  
said device has anatomically rounded features.

32. The implant of claim 13 wherein:  
said device has anatomically rounded features.

15 33. The implant of claim 26 wherein:  
said device has anatomically rounded features.

20 34. The implant of claim 8 wherein:  
said device is perforated in order to increase flexibility.

35. The implant of claim 13 wherein:  
said device is perforated in order to increase flexibility.

25 36. The implant of claim 26 wherein:  
said device is perforated in order to increase flexibility.

37. A method of relieving pain due to the development of  
spinal stenosis and the like in the spinal column including the steps of:

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accessing adjacent first and second spinous processes of the spinal column;

distracting the first and second spinous processes a sufficient amount in order to increase the volume of the spinal canal and/or the neural foramen in the spinal column in order to relieve pain due to the development of spinal stenosis and the like; and

implanting a device in order to maintain the amount of distraction required to relieve the pain due to spinal stenosis and the like.

10

38. The method of claim 37 including the step of:  
distracting apart the first and the second spinous process at least about 5 mm.

15

39. The method of claim 37 including the step of:  
distracting apart the first and the second spinous process from about 5 mm to about 15 mm.

20

40. The method of claim 37 wherein:  
said distracting step and said implanting step occur simultaneously as the step of implanting a device causes distraction.

25

41. The method of claim 37 wherein:  
said device includes a distraction wedge; and  
said distracting step and said implanting step occur simultaneously as the step of implanting a device causes distraction due to the distraction wedge distracting apart the first and the second spinous process.

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42. A method of relieving pain due to the development of spinal stenosis and the like in the spinal column including the steps of:  
accessing adjacent first and second spinous processes of the spinal column;

5           implanting a device in order to distract apart the first and second spinous processes a sufficient amount in order to increase the volume of the spinal canal and/or neural foramen in the spinal column to relieve pain due to the development of spinal stenosis and the like; and  
          using the device in order to maintain the amount of distraction  
10       required to relieve the pain due to spinal stenosis and the like.

43. The method of claim 37 including the step of:  
maintaining intact the supraspinous ligament.

15       44. The method of claim 42 including the step of:  
maintaining intact the supraspinous ligament.

45. The device of claim 8 wherein:  
said implant provides for dynamic distraction between the first  
20       and the second spinous processes by including a fluid filled vessel.

46. The device of claim 22 wherein:  
said fastener is part of the first member and part of the second  
member.

25       47. The device of claim 46 wherein:  
said fastener is self-engaging such that by urging the first member and the second member together in order to assembly the device a portion of the fastener in the first member engages a second  
30       portion of the fastener in the second member.

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48. A method of relieving pain due to the development of spinal stenosis and the like in the spinal column including the steps of:

accessing adjacent first and second spinous processes of the spinal column with first and second incisions;

5       distracting the first and second spinous processes a sufficient amount in order to increase the volume of the spinal canal and/or neural foramen in the spinal column in order to relieve pain due to the development of spinal stenosis and the like; and

      implanting a first portion of a device through said first incision  
10       and a second portion of said device through said second incision, until said devices can be mated;

      said device including a fastener, with the fastener used in a step of securing the first portion to the second portion in the mated configuration in order to maintain the amount of distraction required  
15       to relieve the pain due to spinal stenosis and the like.

49. The method of claim 48 including:

      using a tool having a first arm on to which is mounted the first portion of the device and a second arm on to which is mounted the  
20       second portion of the device in order to urge the first portion and the second portion through the respective first and second incisions and in to mating position.

50. A method of relieving pain due to the development of spinal stenosis and the like in the spinal column including the steps of:

accessing adjacent first and second spinous processes of the spinal column with first and second incisions;

      implanting a first portion of a device through said first incision and a second portion of said device through said second incision, until  
30       said devices can be mated, and simultaneously distracting the first

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and second spinous processes a sufficient amount in order to increase the volume of the spinal canal and/or neural foramen in the spinal column in order to relieve pain; and

5        said device including a fastener, with the fastener used in a step of securing the first portion to the second portion in the mated configuration in order to maintain the amount of distraction required to relieve the pain.

10        51. An implant for relieving pain associated with the spinal column comprising:

      a device that is adapted to be positionable between a first spinous process and a second spinous process;

      said device including a first forked end and a second forked end;

15        said device including an interbody which is operably connected to the first and second forked ends so that rotation of the interbody causes the first and second forked ends to move apart from each other in order to distract the first and the second spinous processes with respect to each other.

20        52. A method using an implant for relieving pain associated with the spinal column comprising the steps of:

      accessing the space between a first spinous process and a second spinous process of the spinal column;

25        positioning an implant between the first spinous process and the second spinous process;

      wherein said implant includes a first means for not limiting flexion of the spinal column; and

      said implant including a second means for limiting extension of the spinal column.

30

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53. A method of relieving pain using a spinal column implant comprising the steps of

accessing the space between a first spinous process and a second process;

5 positioning the implant between the first spinous process and the second spinous process;

wherein said device including a spinal column extension stop; and

said device includes a spinal column flexion non-inhibitor.

10

54. The method of claim 48 wherein:

the distracting step includes wedging the first and second spinous processes apart.

15 55. A method for relieving pain associated with the spinal column including the steps of:

accessing first and second spinous processes;

distracting the first and second spinous processes in order to increase the volume of a spinal cord and/or neural foramen in the spinal column;

20

implanting a device between the first and second spinous processes to do one of (1) further distracting and maintaining the distraction of the first and second spinous processes, and (2) maintaining the distraction of the first and second spinous processes.

25

56. The method of claim 55 wherein the distracting step includes:

multiple distracting steps with a time period between distracting steps in order to allow the tissues associated with the spine to creep.

30

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57. A method for relieving pain associated with the spinal column including the steps of:

accessing first and second spinous processes;

5     implanting a device in order to distract the first and second spinous processes to increase the volume of a spinal canal and/or neural foramen in the spinal column; and

maintaining the distraction with the device.

58. The method of claim 57 wherein the implanting step  
10 includes:

multiple distracting steps with a time period between distracting steps in order to allow the tissues associated with the spine to creep.

59. A method for relieving pain associated with the spinal  
15 column comprising the steps of:

20     implanting a device between a first spinous process and a second spinous process, said device including a first forked end and a second forked end, and said device including an interbody piece which is operably connected to the first and second forked ends so that rotation of the interbody piece causes the first and second forked ends to move apart in order to distract the first and the second spinous processes with respect to each other; and

25     distracting the spinous processes by rotating the interbody piece.

60. The method of claim 42 for relieving pain caused by at least one of spinal stenosis and facet arthropathy.

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61. An implant for flattening the spine in order to increase the volume of at least one of the spinal canal and the neural foramen comprising:

5 a central body with first and second saddles which are adapted to receive adjacent spinous processes;

a first arm projecting from the first saddle, and a second arm projection from the second saddle; and

wherein said central body and the first and second arms form a Z-shaped structure.

10

62. The implant of claim 61 wherein:

the first and second arms are forward migration inhibitors which prevent the implant from migrating toward the spinal canal.

15

63. The implant of claim 61 wherein:

the first and second arms are contoured to the lamina of the spine.

20

64. The implant of claim 61 wherein:

said implant is designed to conform to the bone structure between at least one of the L4-L5 and or the L5-S1 spinous processes.

65. An implant for relieving pain associated with the spinal column comprising:

25 a device which is adapted to be positioned between a first spinous process and a second spinous process;

said device being Z-shaped with a first member extending in a first direction and a second arm extending in another direction;

30 and wherein said first arm is adapted to be inserted between and guided through the space between the first and the second

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spinous processes so that the implant can be positioned with one member on one side of the spinous processes and the second member on the other side of the spinous processes.

5           66.    The implant of claim 65 wherein:  
              said first and second members are flexible.

              67.    A method of relieving pain due to the development of  
spinal stenosis and the like in the spinal column including the steps of:  
10           accessing adjacent first and second spinous processes of the  
spinal column from one side;

              position a Z-shaped implant between the spinous processes in  
order to either distract and maintain the distraction between the  
spinous processes and/or to maintain a distraction between the two  
15           spinous processes;

              wherein said Z-shaped implant has first and second members  
extending from a central body, and the positioning step includes  
guiding the first arm between a space between the first and second  
spinous processes until the central body is located between the  
20           spinous processes with the first arm on one side of the spinous  
processes and the second arm on the other side of the spinous  
processes.

              68.    The method of claim 67 including the steps of:  
25           selecting arms that are contoured to the spine; and  
              positioning the arms adjacent to the portion of the spine for  
which they are contoured.

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69. The method of claim 67 including the steps of:  
selecting arms that are contoured to be positioned adjacent to  
one of L4-L5 and L5-S1 vertebrae; and  
positioning the implant between the vertebrae for which the  
5 implant was contoured.

70. The implant of claim 1 including:  
a third means for preventing migration of the implant toward the  
lamina of the spinal column.

10

71. The implant of claim 8 including:  
said device includes a lamina migration inhibitor.

72. An implant for relieving pain associated with the spinal  
15 column comprising:  
a central body  
a first arm extending from the central body;  
a second arm received in a first position in the central body and  
movable between said first position and a second position extending  
20 from the central body in order so that the first and the second arms  
can retain the implant relative to first and second spinous processes  
of the spinal column.

73. The implant of claim 72 wherein:  
25 said first and second arms are located on opposite sides of the  
spinous processes when implanted and said arms extend in opposite  
directions with the second arm extended from the central body.

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74. The implant of claim 72 including:

a third arm received in a first position in the central body and movable between said first position and a second position extending from the central body.

5

75. The implant of claim 72 wherein:

said first arm is a peripheral flange extending from and about the central body.

10

76. An implant for flattening the spine in order to increase the volume of at least one of the spinal canal and the neural foramen comprising:

a central body with first and second saddles which are adapted to receive adjacent spinous processes;

15

first and second arms projecting from the first saddle and third and fourth arms projecting from the second saddle;

said first and fourth arms are longer than the central body with the first arm being longer than the fourth arm; and

20

the second and third arms are about the length of the central body and/or shorter than the central body with the second arm being shorter than the third arm.

77. The implant of claim 76 wherein:

25

said third arm is below said first arm and said fourth arm is below said second arm.

78. The implant of claim 76 wherein:

30

said third arm is substantially shorter than the first arm so that the implant can be directed between the space between adjacent spinous processes with the first arm first urged through the space and

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the spinous processes distracted so that the third arm can be urged through the space with the central body positioned between the spinous processes.

5           79.    The implant of claim 76 wherein:  
            said first arm is sloped in a direction away from the central body  
in order to accommodate the shape of a vertebra.

            80.    The implant of clam 76 wherein:  
10           said first, third, and fourth arms are sloped in a direction away  
from the central body in order to accommodate the shape a vertebra.

            81.    The implant of claim 76 wherein:  
            said central body includes a bore therein.

15           82.    The implant of claim 76 wherein:  
            said central body includes a bore therein so that the implant has  
a modulus of elasticity that is compatible with that of bone.

20           83.    The implant of claim 76 wherein:  
            at least one of said saddles is sloped in order to accommodate  
a vertebra.

            84.    The implant of claim 76 wherein:  
25           at least one of said saddles is sloped about approximately 30°  
so as to accommodate a vertebra.

            85.    The implant of claim 76 wherein:  
            at least one of said arms is sloped about approximately 30° so  
30           as to accommodate a vertebra.

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86. The implant of claim 76 wherein:

said first arm has a sloped portion which is sloped in a direction away from the central body; and

5       said first arm has a recess located at a distal end of said sloped portion followed by a convex portion in order to accommodate the shape of a vertebra.

87. The implant of claim 76 wherein:

10       said implant has a modulus of elasticity which is compatible with bone.

88. The implant of claim 76 wherein:

15       said implant has a modulus of elasticity which is approximately about twice that of bone.

89. An implant for flattening the spine in order to increase the volume of at least one of the spinal canal and the neural foramen comprising:

20       a central body with first and second saddles which are adapted to receive adjacent spinous processes;

      first and second arms projecting from the first saddle and third and fourth arms projecting from the second saddle;

      said first and fourth arms are longer than the second and third arms; and

25       said third arm is located below said first arm and said fourth arm is located below said second arm, with said fourth arm located diametrically opposite said first arm in order to facilitate the implantation of the implant between adjacent spinous processes.

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90. An implant for relieving pain associated with the spinal column which is positionable between adjacent spinous processes of the spinal column, comprising:

a first unit including a guide and a first wing;

5 a second wing;

said body including a groove that can receive said second wing, said body adapted for positioning between the adjacent spinous processes, with the first wing positionable along side the adjacent spinous processes and the second wing positionable along side the spinous processes and opposite to the first wing; and

10 a device that secures the second wing to the guide.

91. The implant of claim 90 wherein:

said first wing has upper and lower portions;

15 said second wing has upper and lower portions;

an upper saddle is defined among the body and the upper portions of the first and second wings;

a lower saddle is defined among the body and the lower portions of the first and second wing;

20 wherein the upper width of the upper saddle is defined between the upper portions of the first and second wings;

wherein the lower width of the lower saddle is defined between the lower portions of the first and second wings;

25 the implant comprising multiple second wings with each second wing having said lower portion of a different thickness; and

wherein the lower width can be selected by choosing said second wing with said lower portion of the desired thickness.

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92. The implant of claim 91 wherein:

each second wing has said upper portion with a different thickness; and

wherein the upper width can be selected by choosing said  
5 second wing with said upper portion of the desired thickness.

93. The implant of claim 90 wherein:

said first wing has upper and lower portions;

said second wing has upper and lower portions;

10 an upper saddle is defined among the body and the upper portions of the first and second wings;

a lower saddle is defined among the body and the lower portions of the first and second wing;

wherein the upper width of the upper saddle is defined between  
15 the upper portions of the first and second wings;

wherein the lower width of the lower saddle is defined between the lower portions of the first and second wings;

the implant comprising multiple second wings with each second wing having said upper portion of a different thickness; and

20 wherein the upper width can be selected by choosing said second wing with said portion of the desired thickness.

94. The implant of claim 90 wherein:

at least one of said first wing and said second wing include a  
25 recess in order to accommodate the anatomical form of the vertebrae.

95. The implant of claim 90 wherein:

said first wing has upper and lower portions;

said second wing has upper and lower portions; and

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at least one upper portion has a recess in order to accommodate the anatomical form of the vertebrae.

96. The implant of claim 90 wherein the spinous processes of the spinal column extend from respective vertebral bodies and wherein:

at least one of the first and the second wings has an upper portion;

said upper portion has a recess in order to accommodate the anatomical form of the spinal column; and

wherein said recess is located adjacent to laminae of the vertebrae.

97. The implant of claim 90 wherein:  
said groove is wider at the top than the bottom in order to assist the seating of the second wing in the groove.

98. The implant of claim 90 wherein:  
said body has an end that is located distally from the first wing;  
and  
wherein said end is bulbous.

99. The implant of claim 90 wherein:  
said body has an end that is located distally from the first wing;  
and  
wherein said end is shaped in a manner that assists in the placement of the body between adjacent spinous processes.

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100. The implant of claim 90 wherein:  
said body has an end that is located distally from the first wing;  
and  
wherein said end is pointed.

5

101. The implant of claim 90 wherein:  
said body has an end that is located distally from the first wing;  
and  
wherein said end has first and second sides that are provided at  
an angle of about 30° to about 60° from a longitudinal axis of the  
body.

10

102. The implant of claim 90 wherein:  
said device includes a bore in said body which is provided at an  
acute angle to the body.

15

103. The implant of claim 90 wherein:  
said device includes a bore in said body which is provided at  
about perpendicular to the body.

20

104. The implant of claim 90 wherein:  
said device includes a first bore in the body;  
said second wing has tab extending therefrom, which tab  
includes a second bore there through;

25

wherein with said second wing is received in said groove of said  
body said first and second bores are aligned; and  
said device includes a member that is positioned through the  
first and the second bores in order to secure the second wing to the  
body.

30

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105. The implant of claim 99 wherein:  
said end is removable from said body.

106. An implant for relieving pain associated with the spinal  
5 column which is positionable between adjacent spinous processes of  
the spinal column, comprising:

a first unit including a guide and a first wing;  
a second wing;

10 said body including a means for engaging said second wing  
along a direction from an posterior position along a line toward an  
anterior position, said body adapted for positioning between the  
adjacent spinous processes, with the first wing positionable along side  
the adjacent spinous processes and the second wing positionable  
along side the spinous processes and opposite to the first wing; and  
15 said engaging means is operable along a direction from an  
posterior position along a line toward an anterior position.

107. The implant of claim 90 which does not limit flexion of the  
spinal column while limiting extension of the spinal column.  
20

108. The implant of claim 106 which does not limit flexion of  
the spinal column while limiting extension of the spinal column.

109. The implant of claim 104 wherein:  
25 said body includes a recess that can receive said tab of said  
second wing.

110. The implant of claim 90 wherein:  
said first wing has upper and lower portions;  
30 said second wing has upper and lower portions;

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an upper saddle is defined among the body and the upper portions of the first and second wings;

a lower saddle is defined among the body and the lower portions of the first and second wing;

5            wherein the upper width of the upper saddle is defined between the upper portions of the first and second wings;

             wherein the lower width of the lower saddle is defined between the lower portions of the first and second wings; and

             wherein at least one of the upper width and the lower width is  
10           wider than a spinous process around which the implant is positioned.

111. An implant for relieving pain associated with the spinal column which implant is positionable between adjacent spinous processes of the spinal column, comprising:

15           a distracting unit including a body and a first wing;

             a retaining unit including a second wing and a tab extending from said second wing; said distracting unit defining a groove for receiving at least a portion of said second wing and said distraction unit also defining a recess for receiving said tab;

20           said body including a first bore;

             said tab including a second bore;

             said first and second bores being alignable with the second wing received in said groove; and

             a device that is positionable through the first and second bores  
25           in order to secure the retaining unit to the distraction unit.

112. The implant of claim 111 wherein:

             said first bore is threaded; and

             said device is a screw.

30

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113. The implant of claim 111:

wherein said first and second bores are alignable along a line extending from a posterior position toward an anterior position relative to the spinal column.

5

114. A method of relieving pain due to the development of spinal stenosis and the like in the spinal column including the steps of:  
accessing adjacent first and second spinous processes of the spinal column;

10       implanting a distracting unit between the spinous processes, which distracting unit has (1) a body that can maintain a distraction between the first and second spinous processes and (2) a wing which extends from said body along the spinous processes; and

15       securing a retaining unit to the distracting unit along a line which is from a posterior position to an anterior position.

115. The method of claim 114 wherein the securing step includes:

20       positioning the retaining unit in the distracting unit along a line which is from a posterior position to an anterior position.

116. The method of claim 114 wherein the securing step includes:

25       positioning a screw through the retaining unit and the distracting unit along a line which from a posterior position to an anterior position in order to secure the retaining unit to the distracting unit.

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117. The method of claim 115 wherein the securing step includes:

positioning a screw through the retaining unit and the distracting unit along a line which from a posterior position to an anterior position  
5 in order to secure the retaining unit to the distracting unit.

118. The method of claim 111 wherein said first and second wings have first and second planes respectively, and the method includes positioning said second wing relative to the first wing by  
10 moving the second wing such that the second plane of the second wing remains substantially parallel to the first plane of the first wing as the second wing is moved into engagement with the distracting unit.

119. The method of claim 118 wherein the second wing is secured to the first wing with a fastener which moved along a line that is substantially parallel to the second plane of the second wing in order to secure the retaining unit to the distracting unit.  
15

120. The method of claim 114 including the step of:  
distracting the first and second spinous processes apart prior to inserting the distracting unit between the first and second spinous processes.  
20

121. The method of claim of 114 wherein:  
said inserting step includes using the distracting unit to distract the first and the second spinous processes as the distracting unit is inserted between the first and the second spinous processes.  
25

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122. The implant of claim 90 wherein:

said first wing has upper and lower portions;

said second wing has upper and lower portions;

5 an upper saddle is defined among the body and the upper portions of the first and second wings;

a lower saddle is defined among the body and the lower portions of the first and second wing;

wherein the upper width of the upper saddle is defined between the upper portions of the first and second wings;

10 wherein the lower width of the lower saddle is defined between the lower portions of the first and second wings;

there is a height between the upper and the lower saddles; and

wherein the upper width is from about 6mm to about 8mm, with the lower width being from about 5mm to about 7mm and the height is from about 8mm to about 10mm.

123. The implant of claim 90 wherein:

said first wing has upper and lower portions;

said second wing has upper and lower portions;

20 an upper saddle is defined among the body and the upper portions of the first and second wings;

a lower saddle is defined among the body and the lower portions of the first and second wing;

25 wherein the upper width of the upper saddle is defined between the upper portions of the first and second wings;

wherein the lower width of the lower saddle is defined between the lower portions of the first and second wings; and

there is a height between the upper and the lower saddles; and

30 wherein a trapezoidal shape is defined between the upper width, the lower width and the height.

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124. The implant of claim 90 wherein:

said first wing has upper and lower portions;

said second wing has upper and lower portions;

an upper saddle is defined among the body and the upper  
5 portions of the first and second wings;

a lower saddle is defined among the body and the lower portions  
of the first and second wing;

wherein the upper width of the upper saddle is defined between  
the upper portions of the first and second wings;

10 wherein the lower width of the lower saddle is defined between  
the lower portions of the first and second wings;

there is a height between the upper and the lower saddles; and

the implant has at least one of the following combinations of  
dimensions:

- 15 (a) an upper width of about 6mm, a lower width of  
about 5mm and a height of about 8mm;
- (b) an upper width of about 7mm, a lower width of  
about 6mm and a height of about 9mm; and
- (c) an upper width of about 8mm, a lower width of  
20 about 7mm and a height of about 10mm.

125. The implant of claim 90 wherein:

a portion of said body located between the first and second  
wings defines a trapezoidal shape.

25

126. An implant for relieving pain associated with the spinal  
column which implant is positionable between adjacent spinous  
processes of the spinal column, comprising:

a distracting unit including a body and a first wing;

- 69 -

a retaining unit including a second wing which is securable to the body;

the first and second wings having upper portions and lower portions respectively;

5 the upper portions of the first and second wings and the portion of the body located there between defining an upper saddle;

the lower portions of the first and second wings and the portion of the body located there between defining a lower saddle; and

10 the portion of the body located between the first and the second saddles defining a trapezoidal shape.

127. An implant for relieving pain associated with the spinal column which implant is positionable between adjacent spinous processes of the spinal column, comprising:

15 a distracting unit including a body;

a retaining unit which is securable to the body;

said distracting unit and the retaining unit together defining a first saddle and a second saddle, each saddle adapted for receiving a spinous process; and

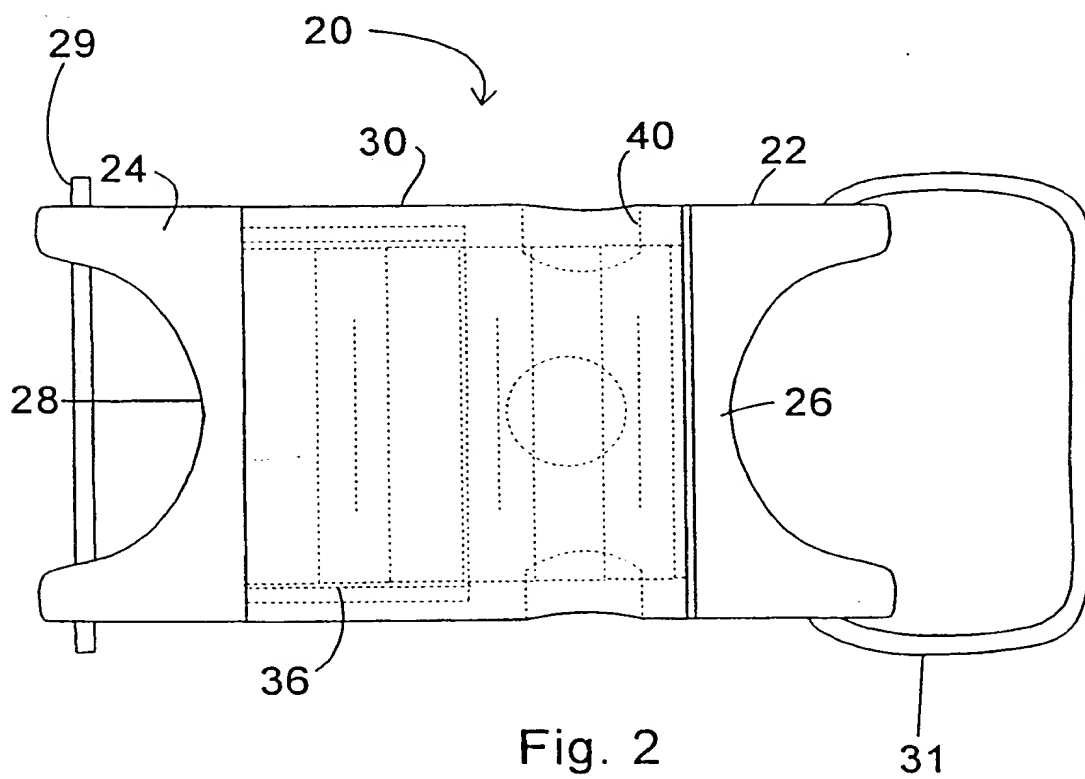
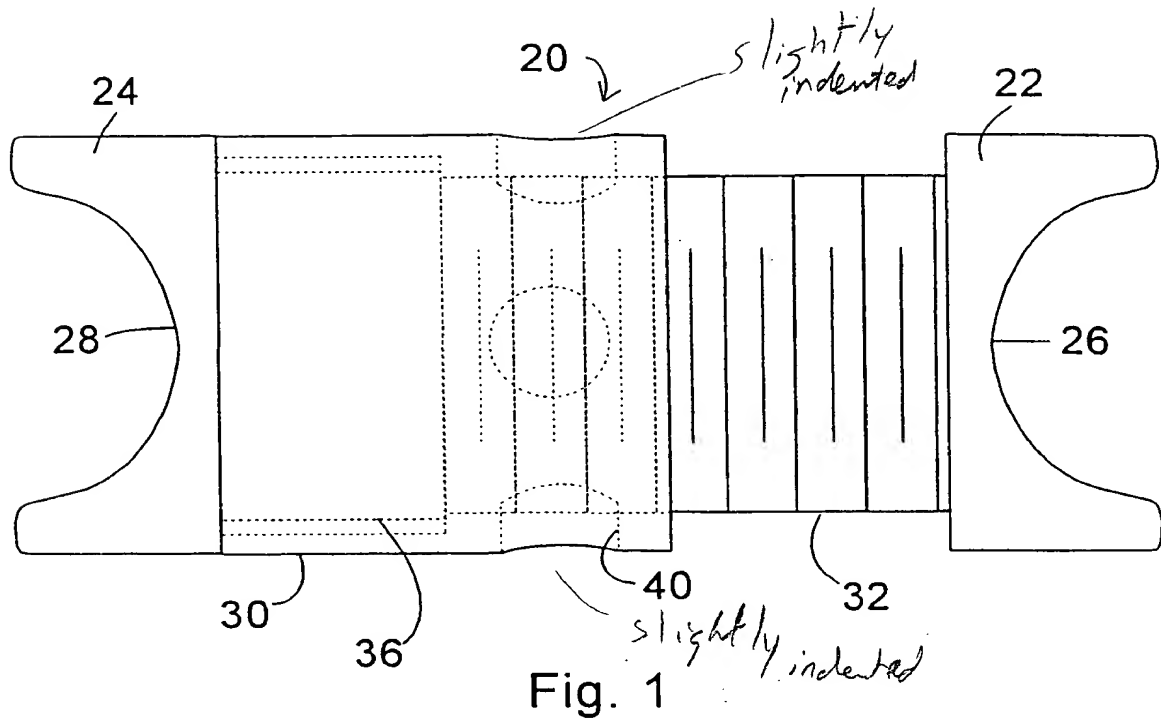
20 wherein the first saddle has a first width and the second saddle has a second width and wherein the first width is different from the second width.

128. The implant of claim 127 wherein:

25 said first saddle is for receiving an upper spinous process and the second saddle is for receiving a lower spinous process.

129. The implant of claim 127 wherein:

30 a portion of the body located between the first and the second saddles is substantially trapezoidal shaped.



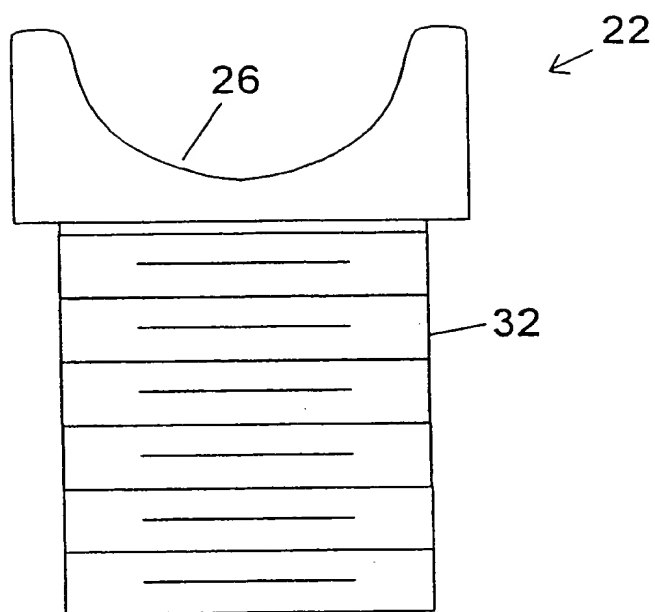


Fig. 3a

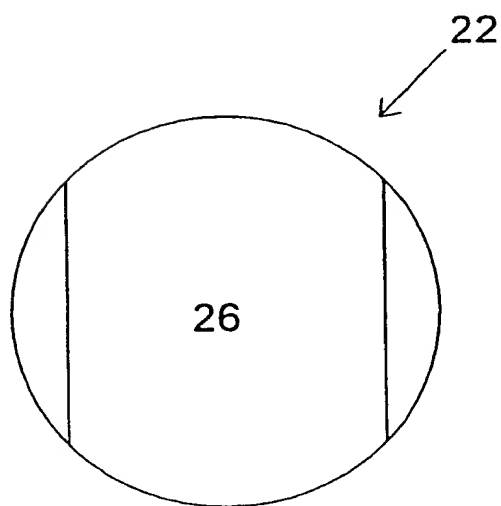


Fig. 3b

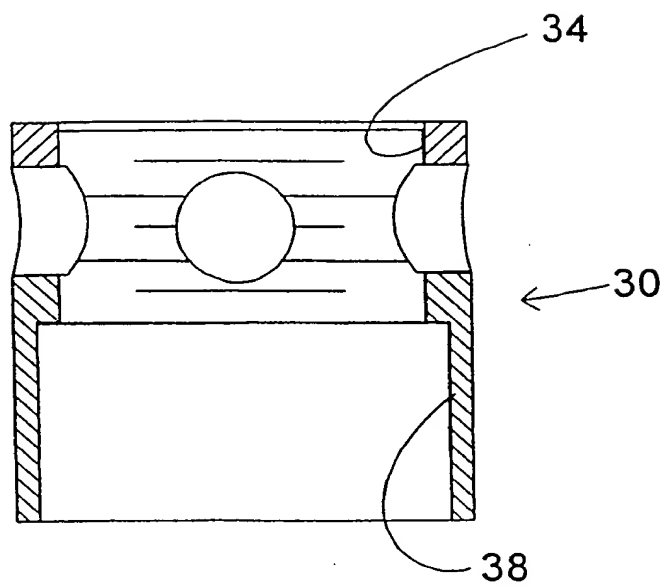


Fig. 4a

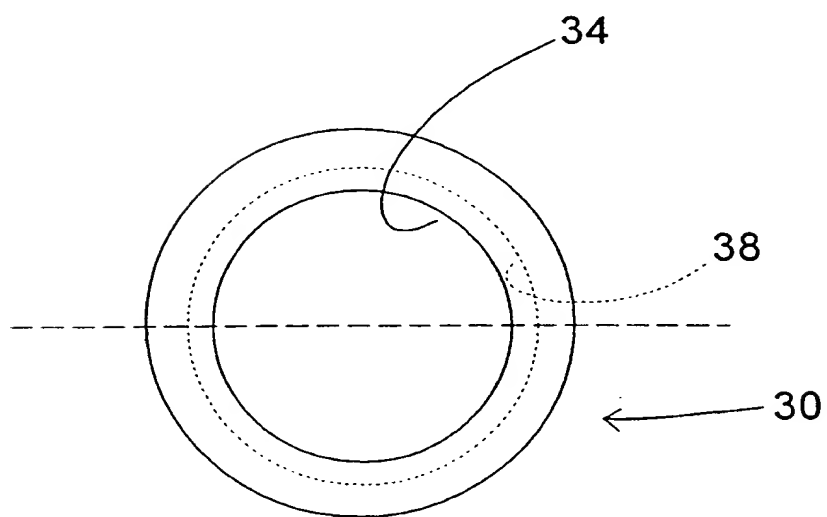


Fig. 4b

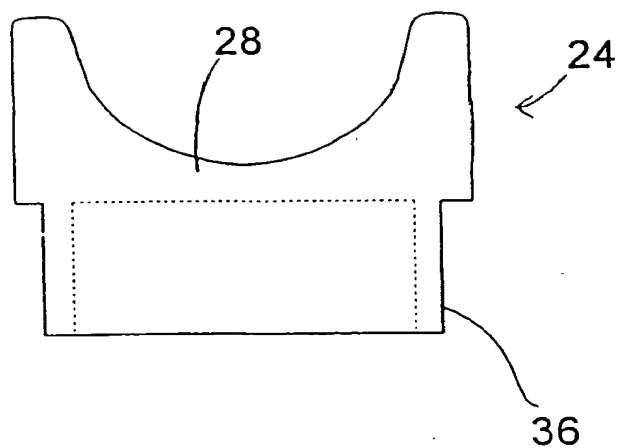


Fig. 5a

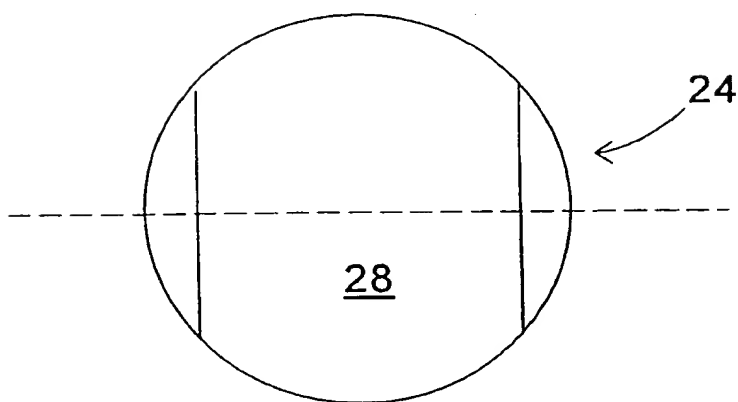
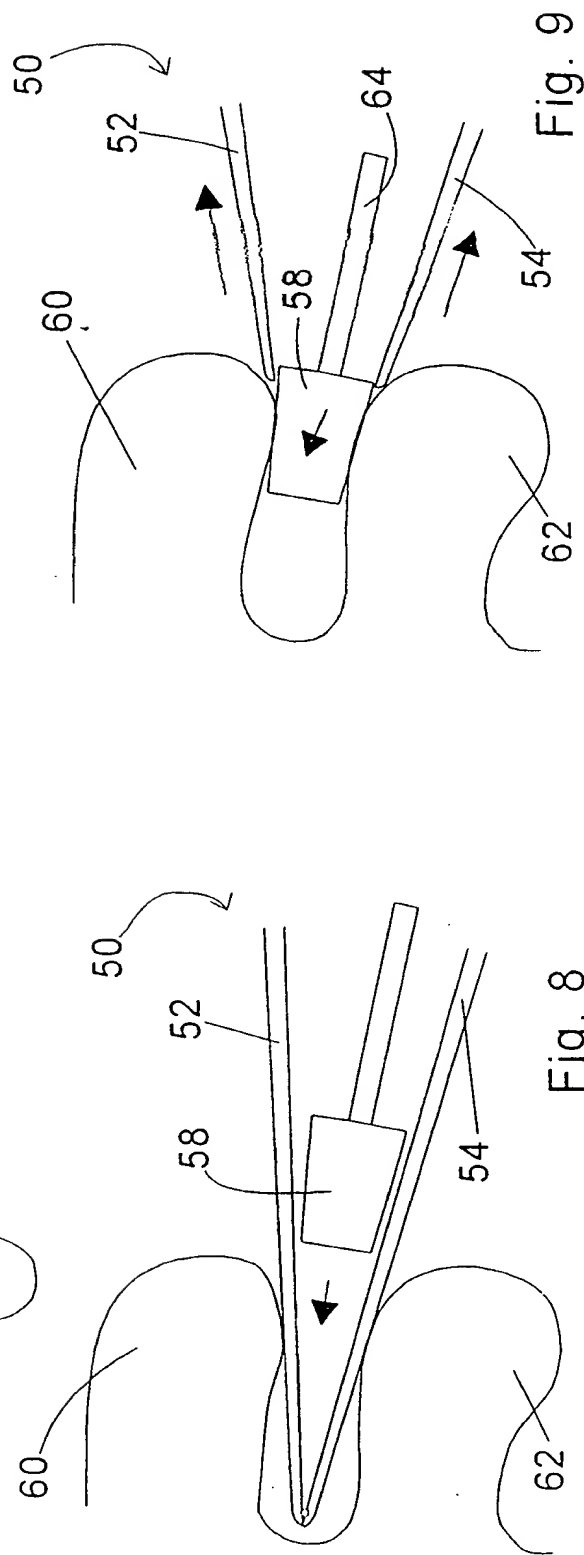
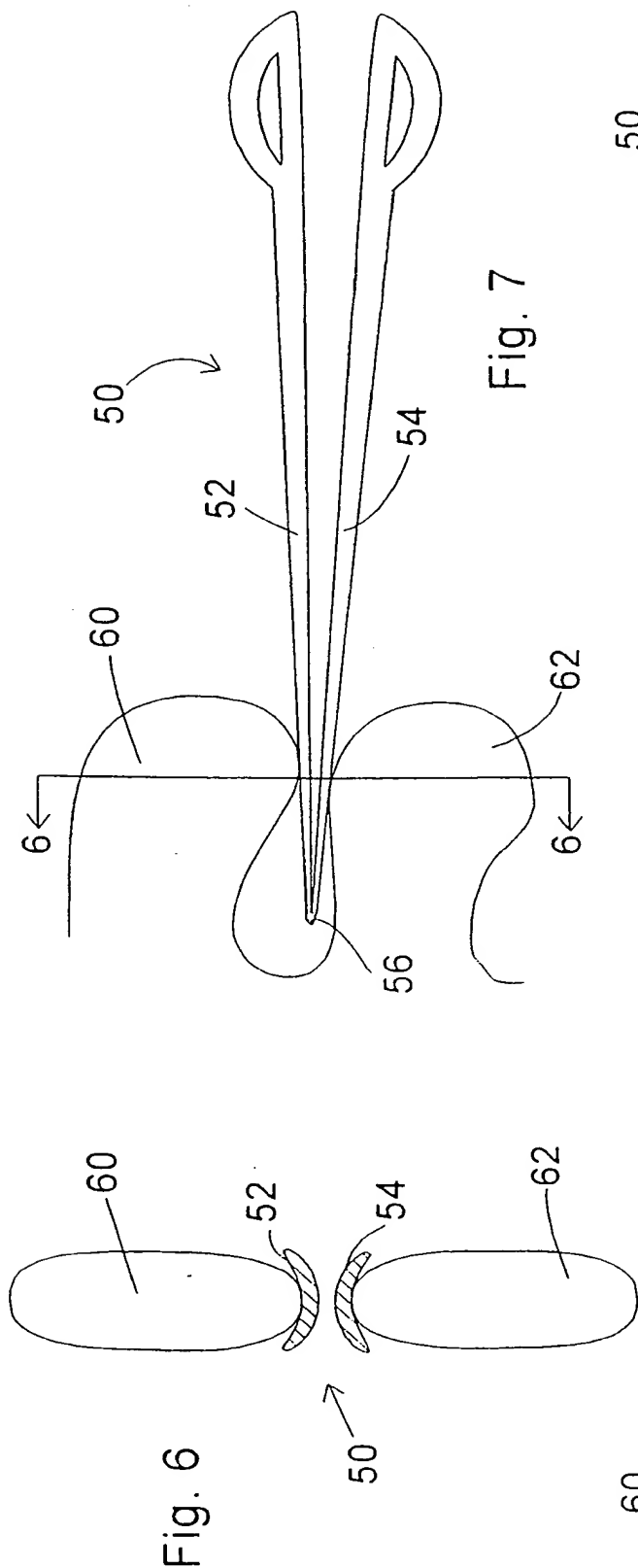


Fig. 5b



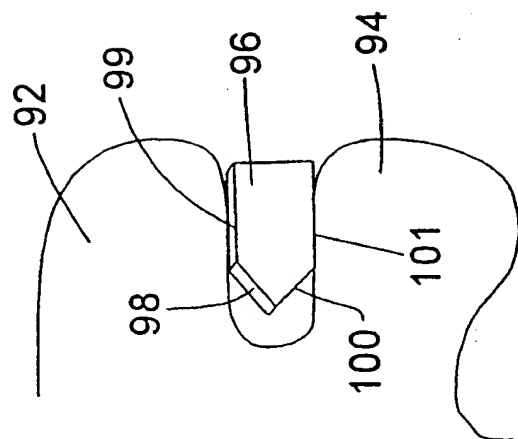


Fig. 11

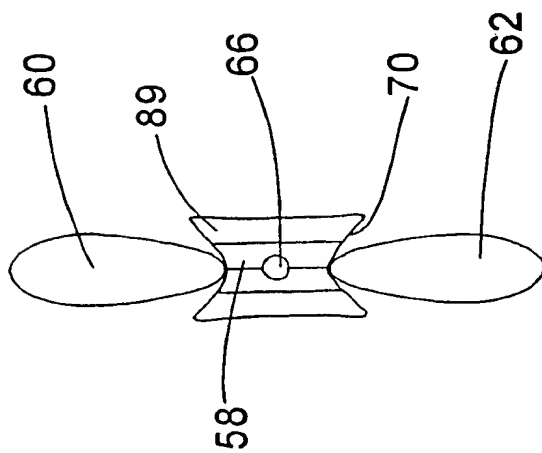


Fig. 10

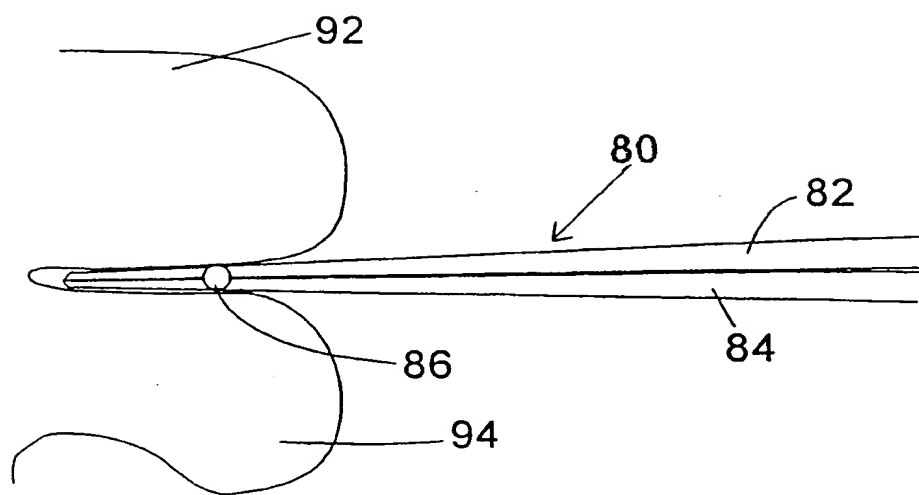


Fig. 12

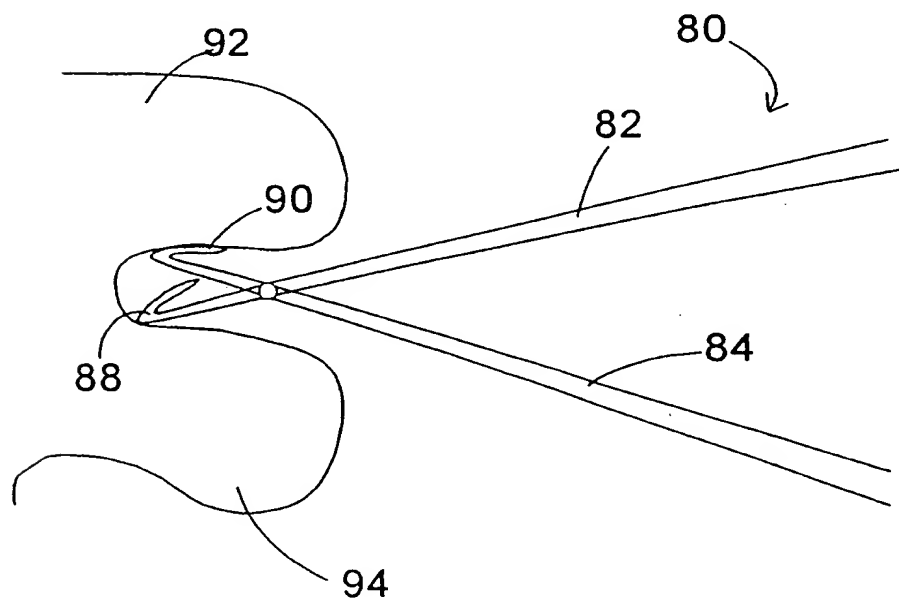


Fig. 13

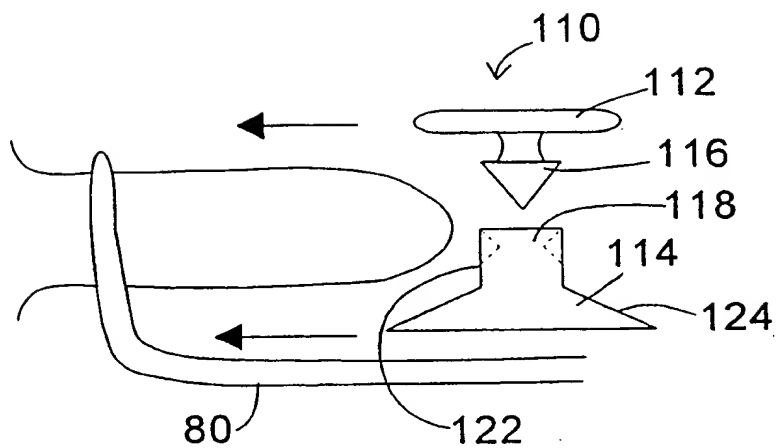


Fig. 14

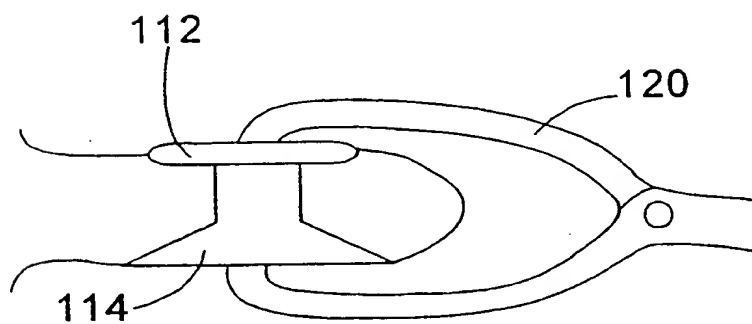


Fig. 15

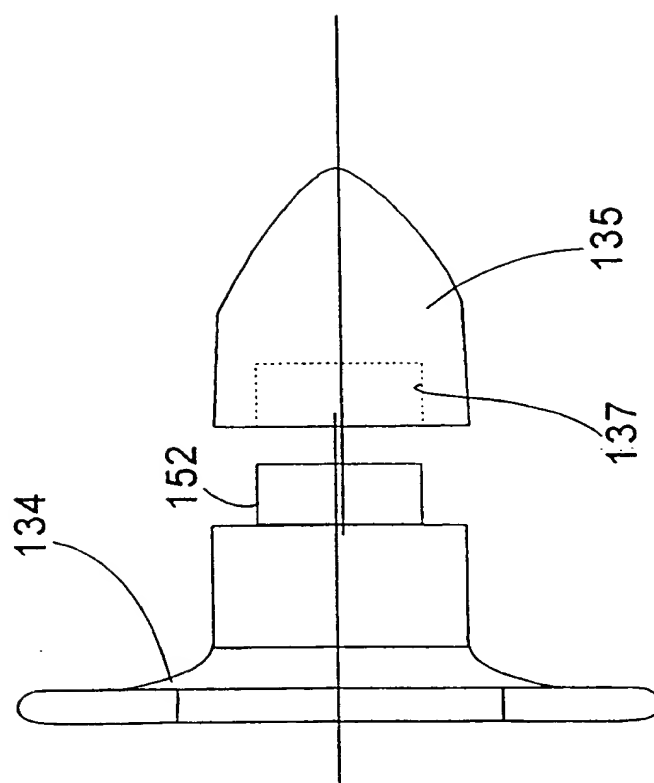
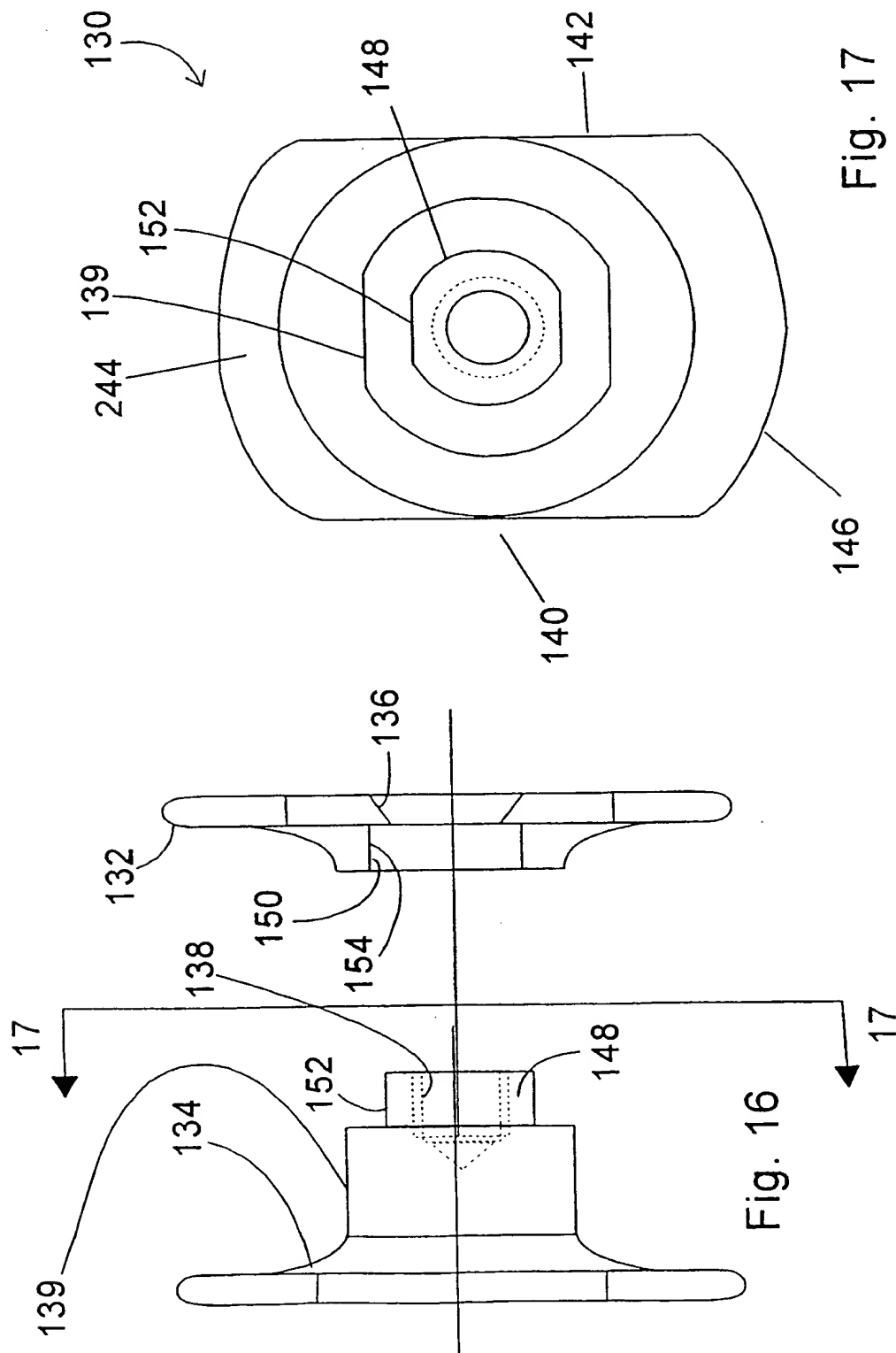


Fig. 16a



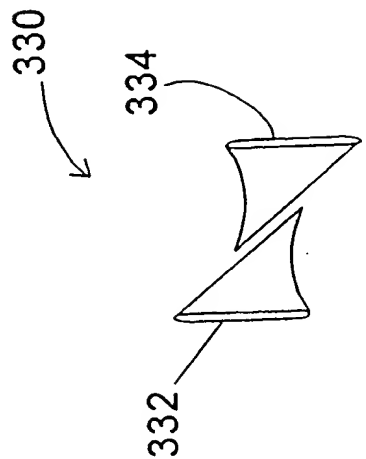


Fig. 18

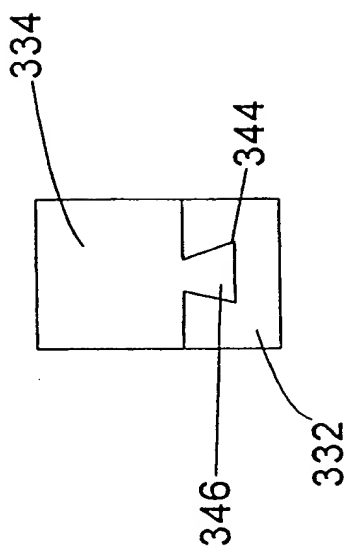


Fig. 19

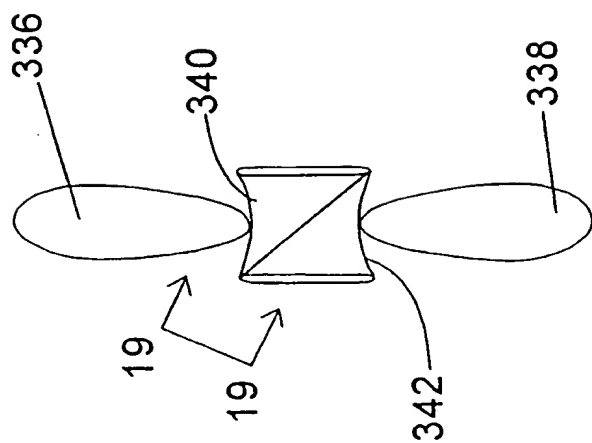


Fig. 20

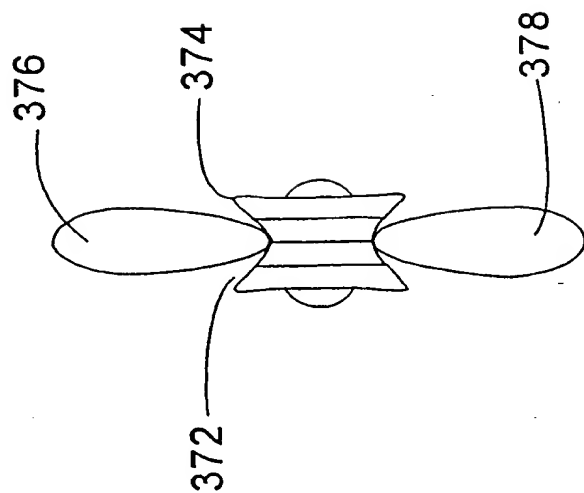


Fig. 22

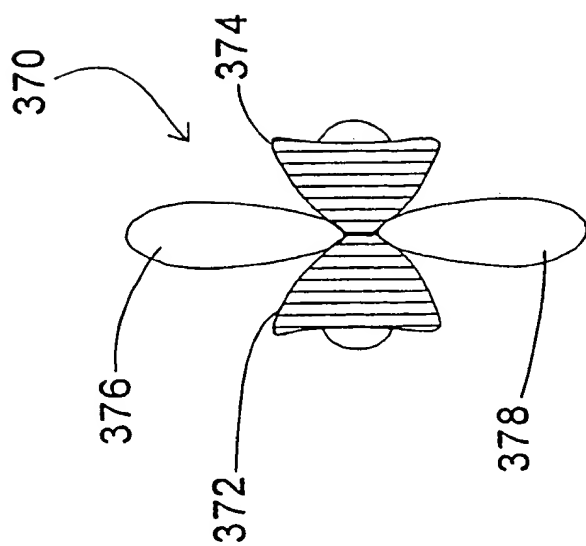


Fig. 21

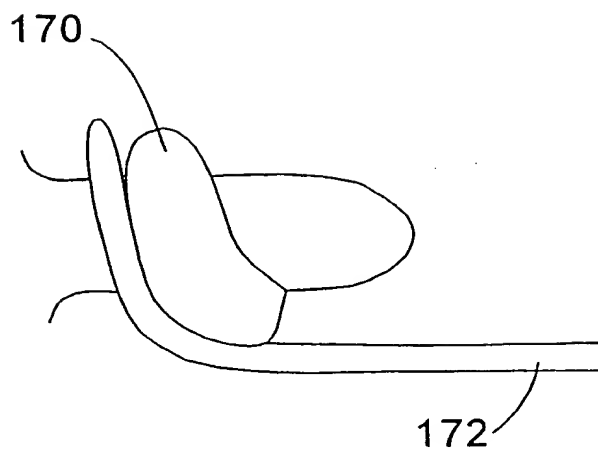


Fig. 24

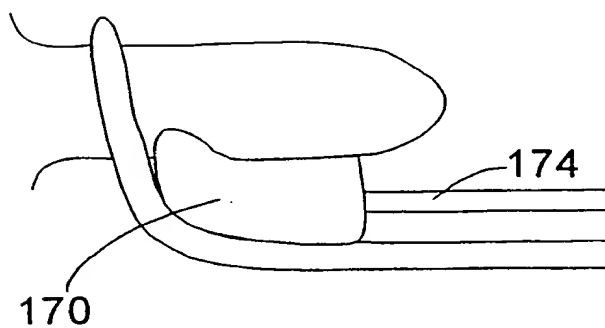


Fig. 23

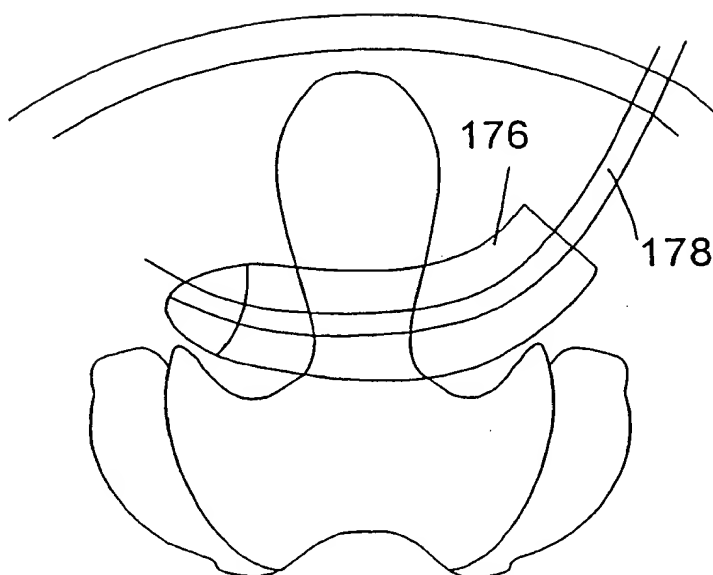


Fig. 25

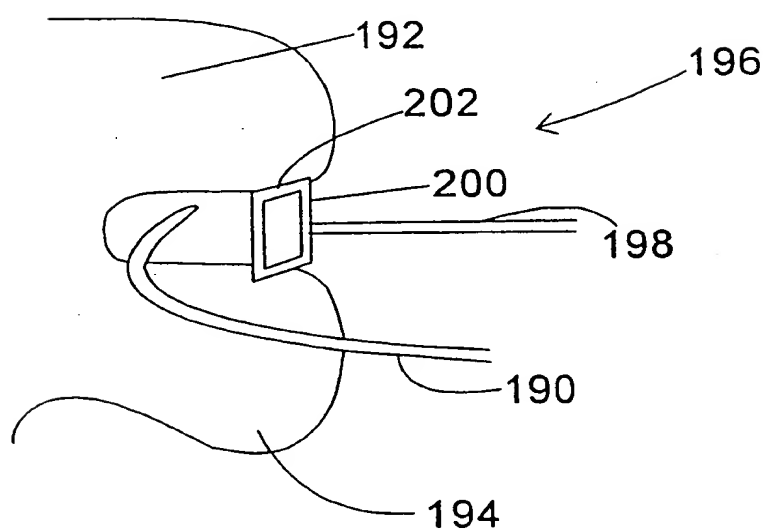
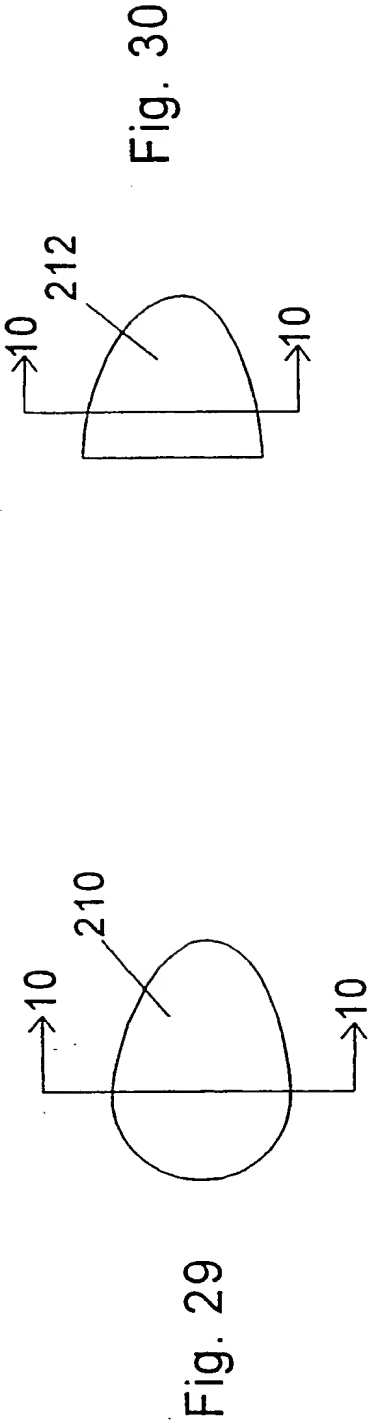
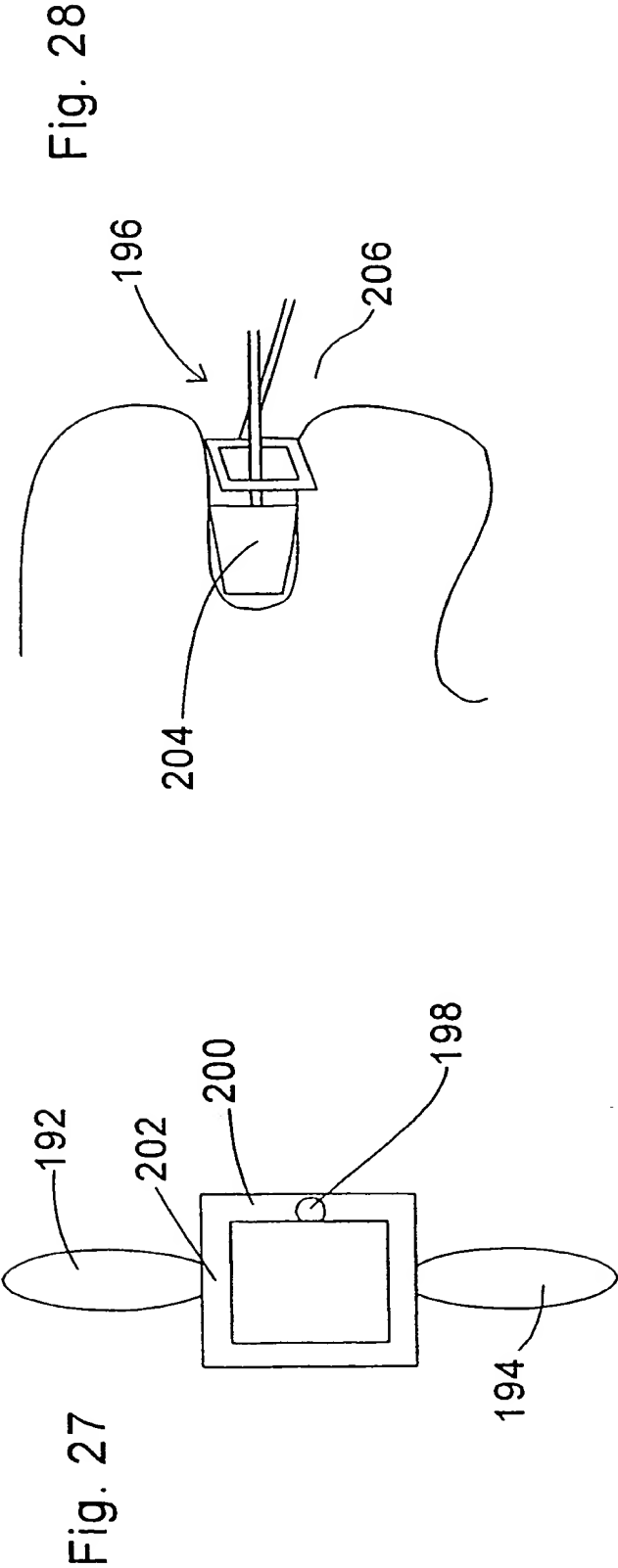


Fig. 26

SUBSTITUTE SHEET ( rule 26 )



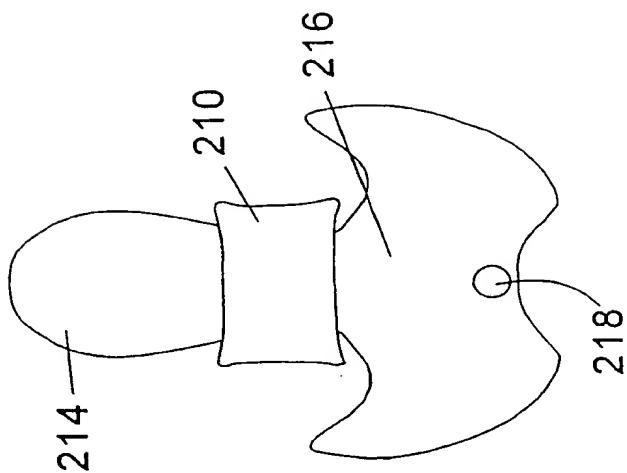


Fig. 33

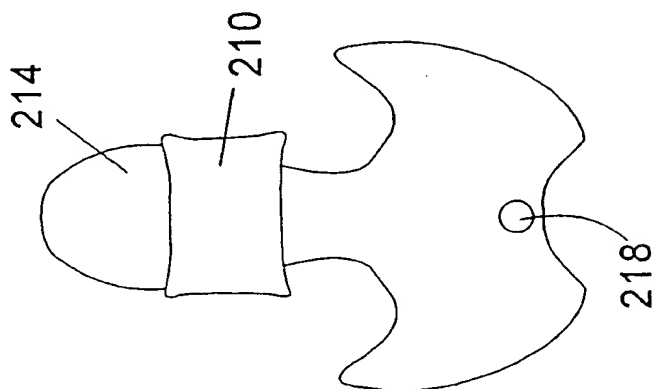


Fig. 32

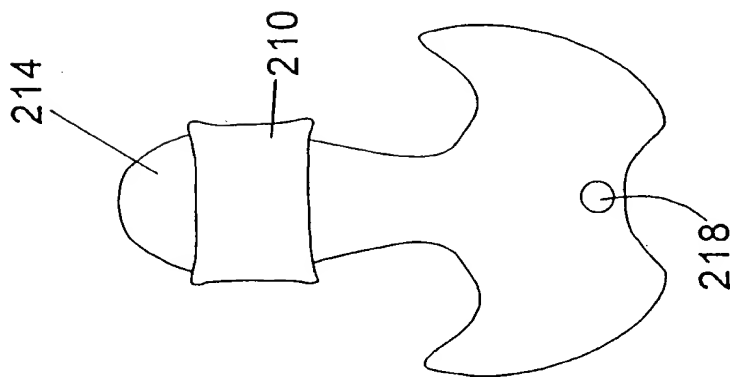


Fig. 31

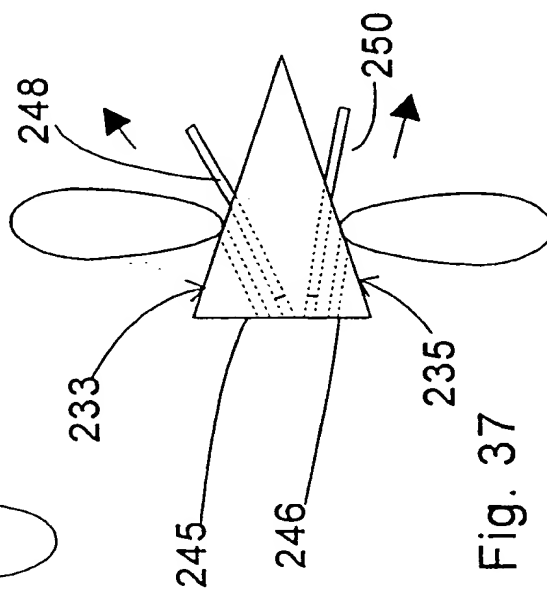
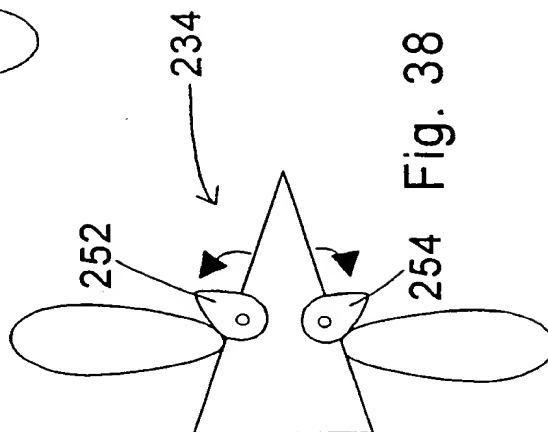
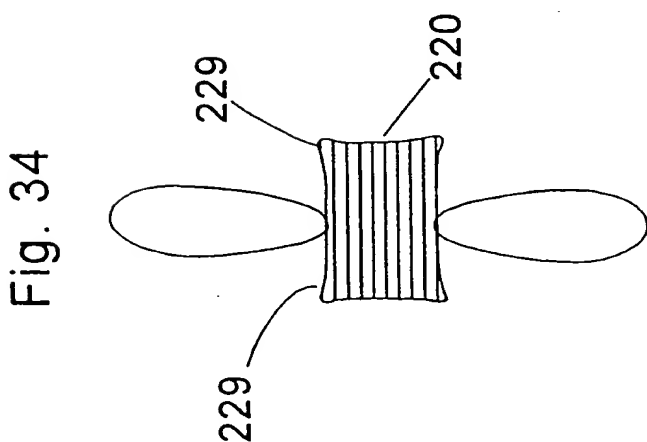
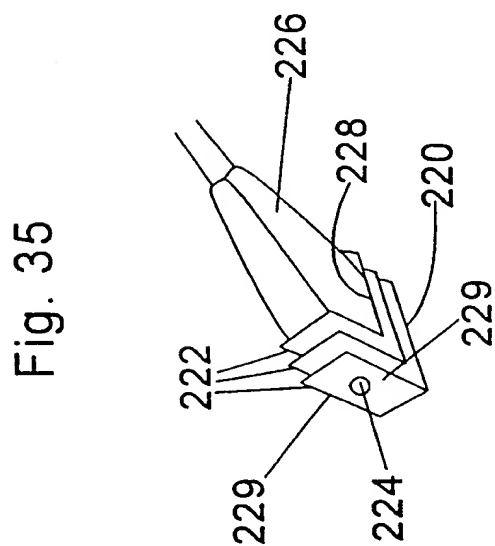
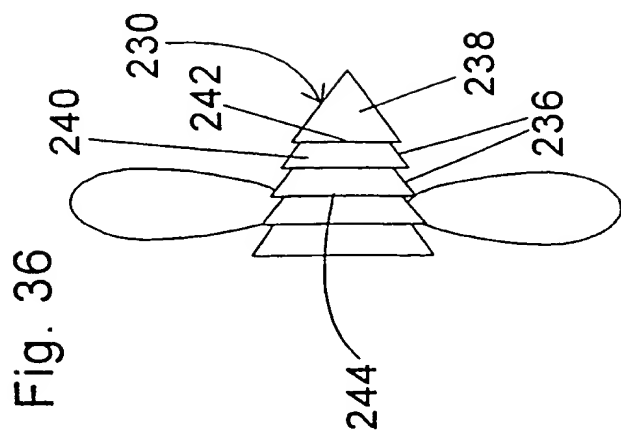
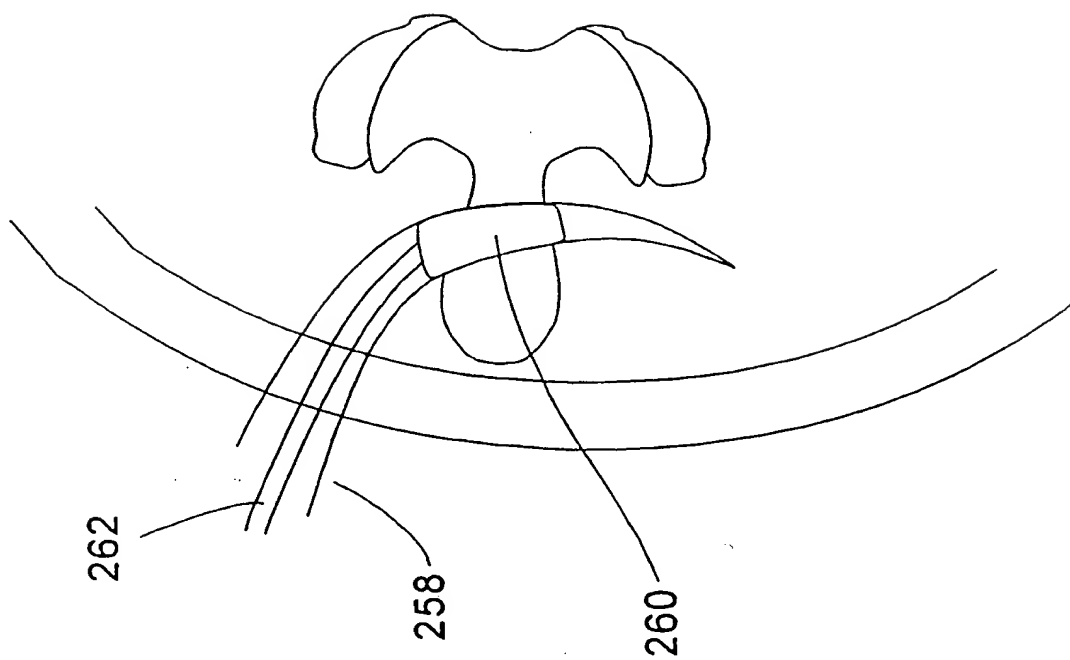


Fig. 39



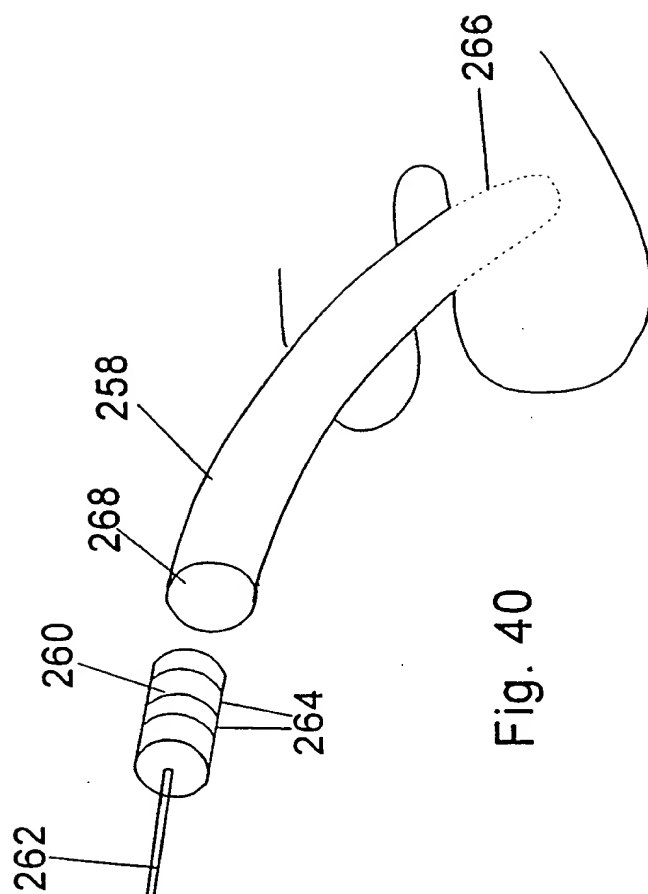


Fig. 40

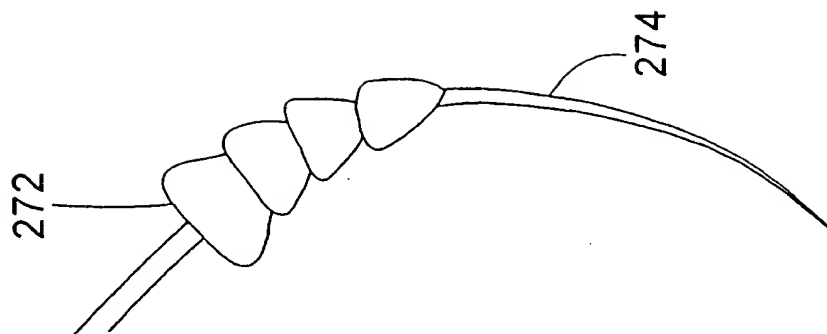


Fig. 43

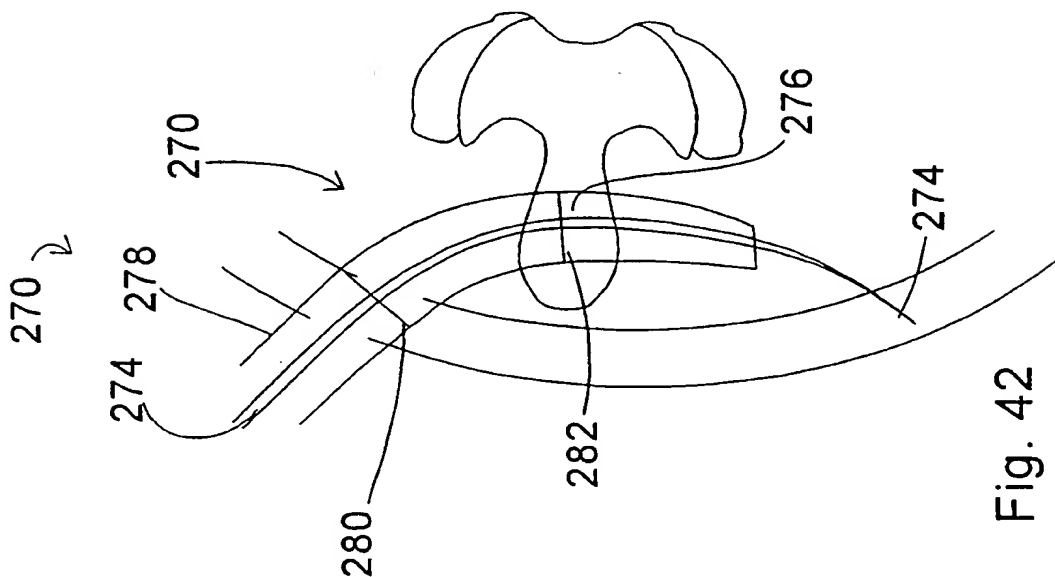


Fig. 42

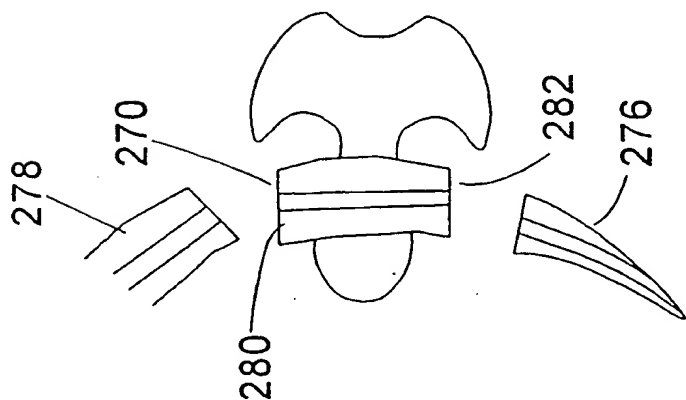


Fig. 41

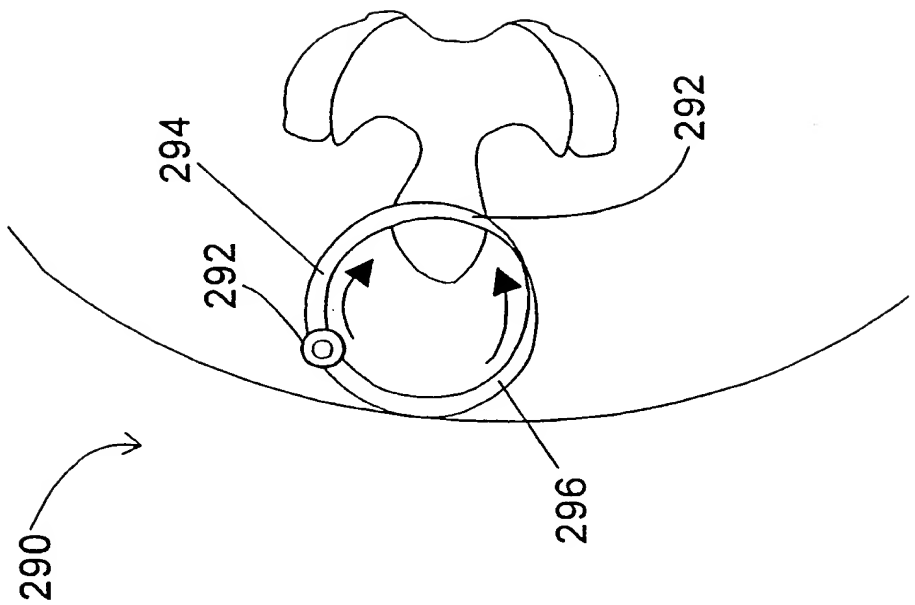


Fig. 44

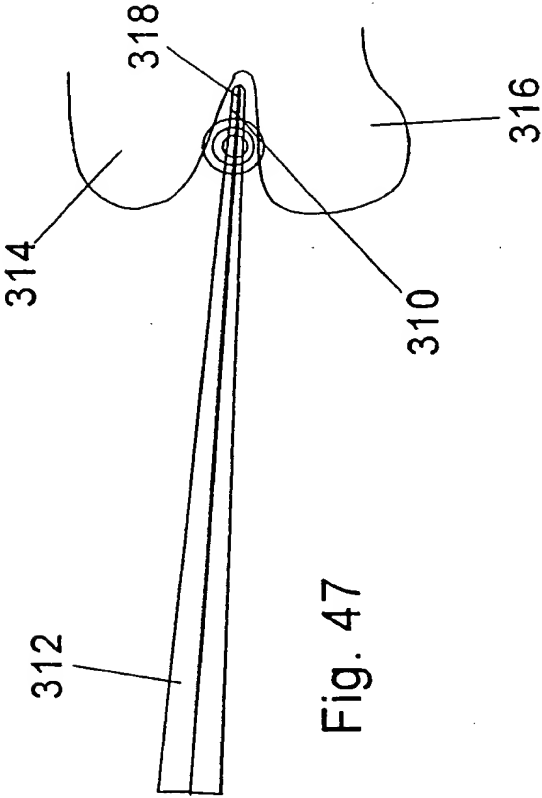


Fig. 47

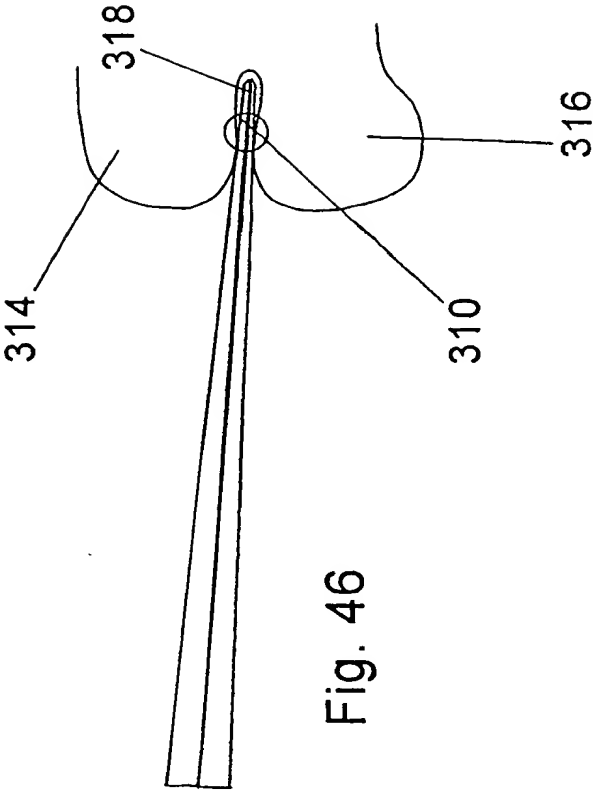


Fig. 46

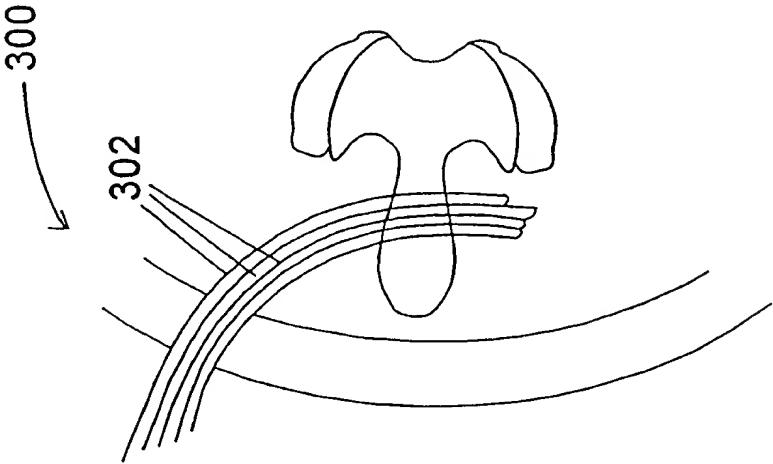


Fig. 45

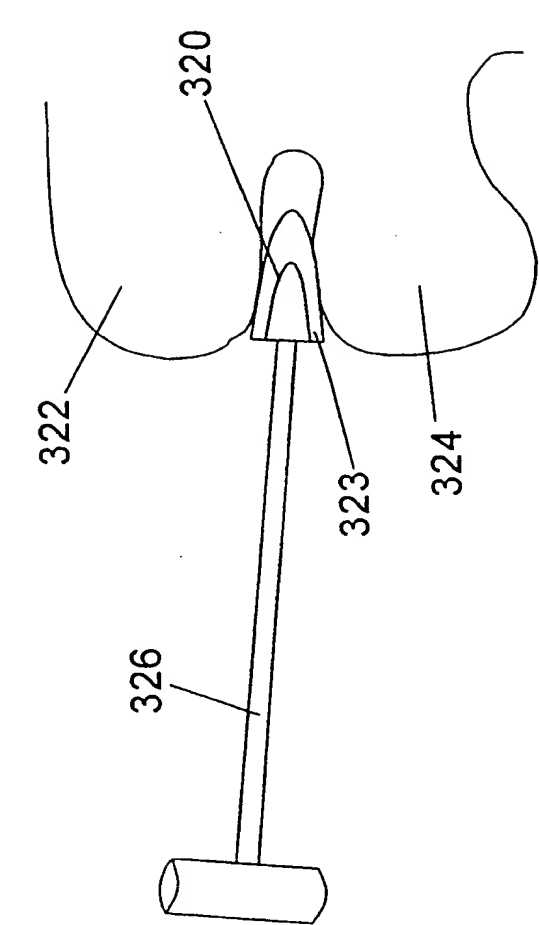


Fig. 48

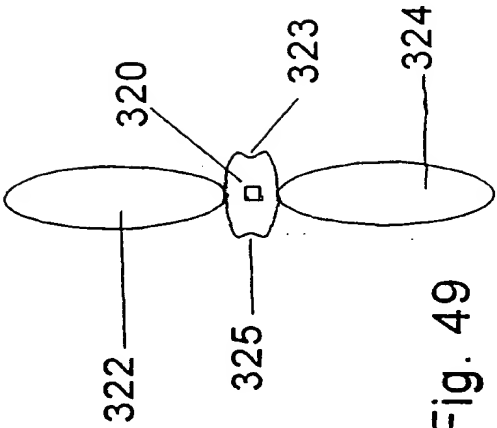


Fig. 49

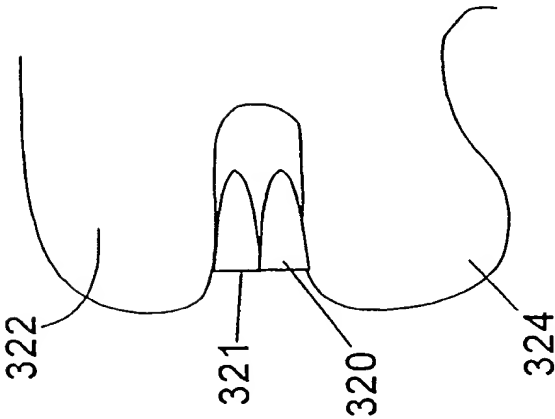


Fig. 51

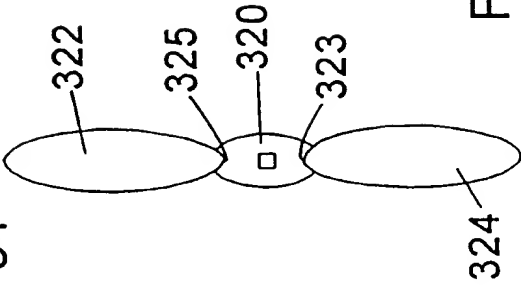


Fig. 50

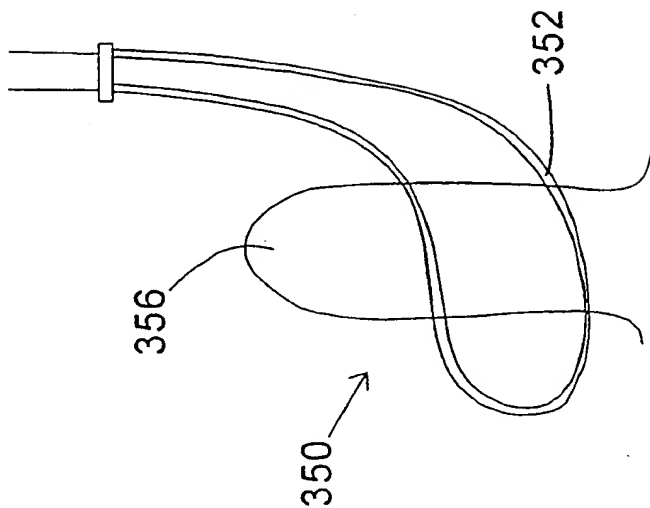


Fig. 54

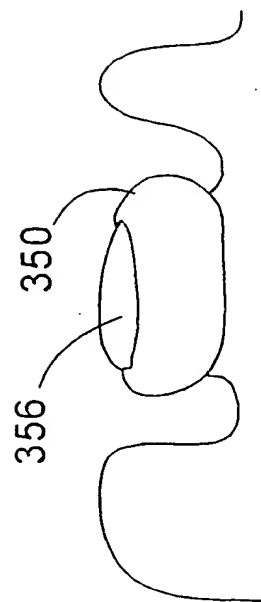


Fig. 55b

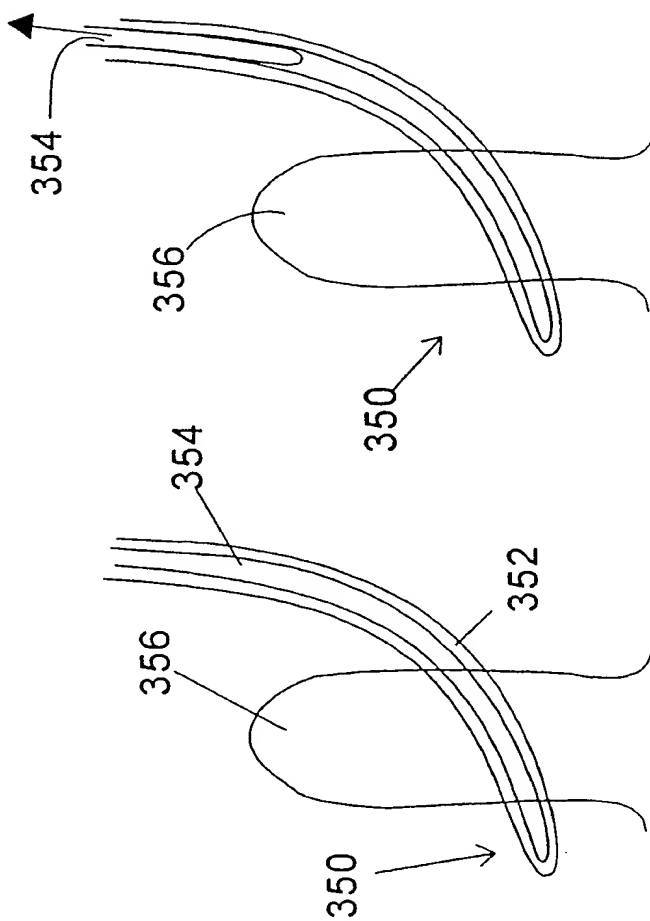


Fig. 53

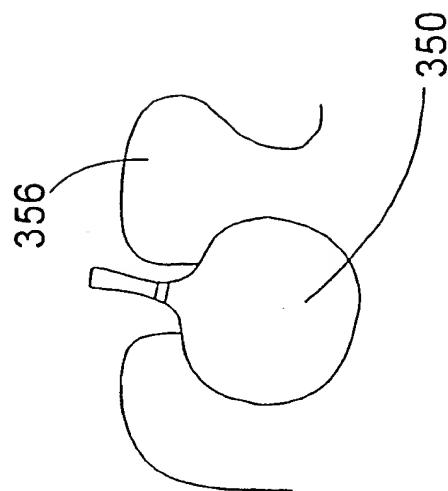


Fig. 55a

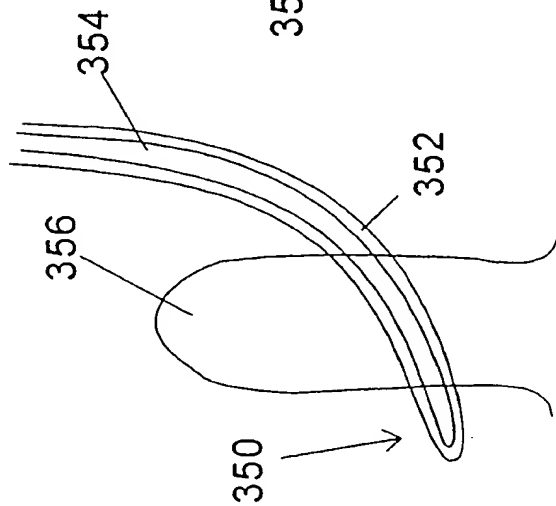


Fig. 52

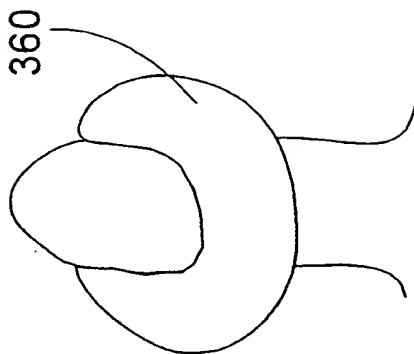


Fig. 58

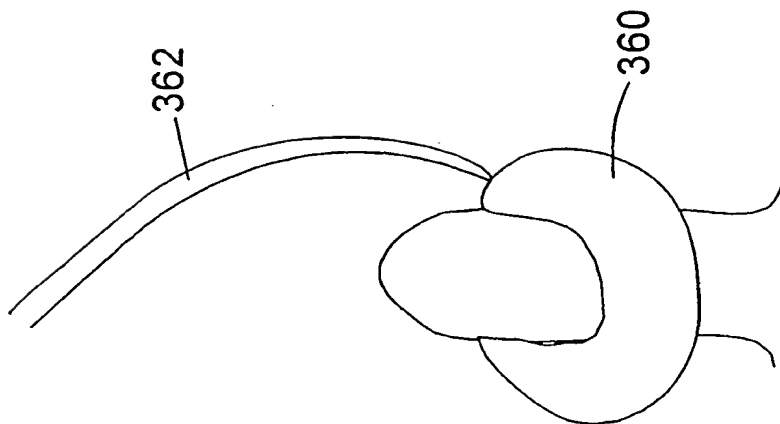


Fig. 57

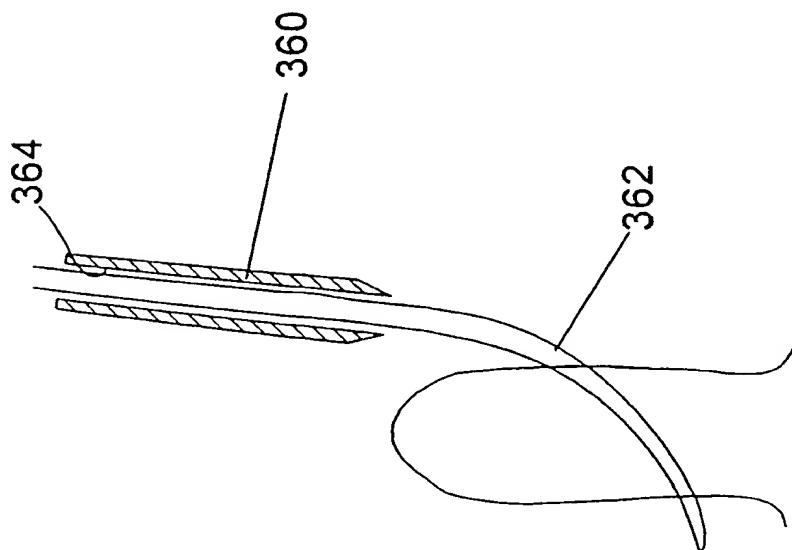


Fig. 56

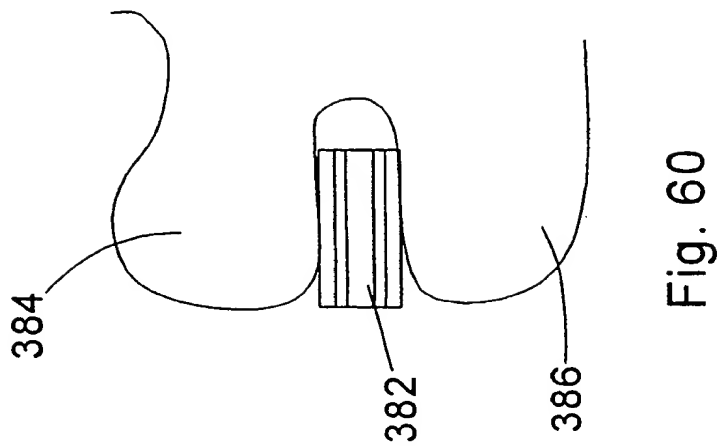


Fig. 60

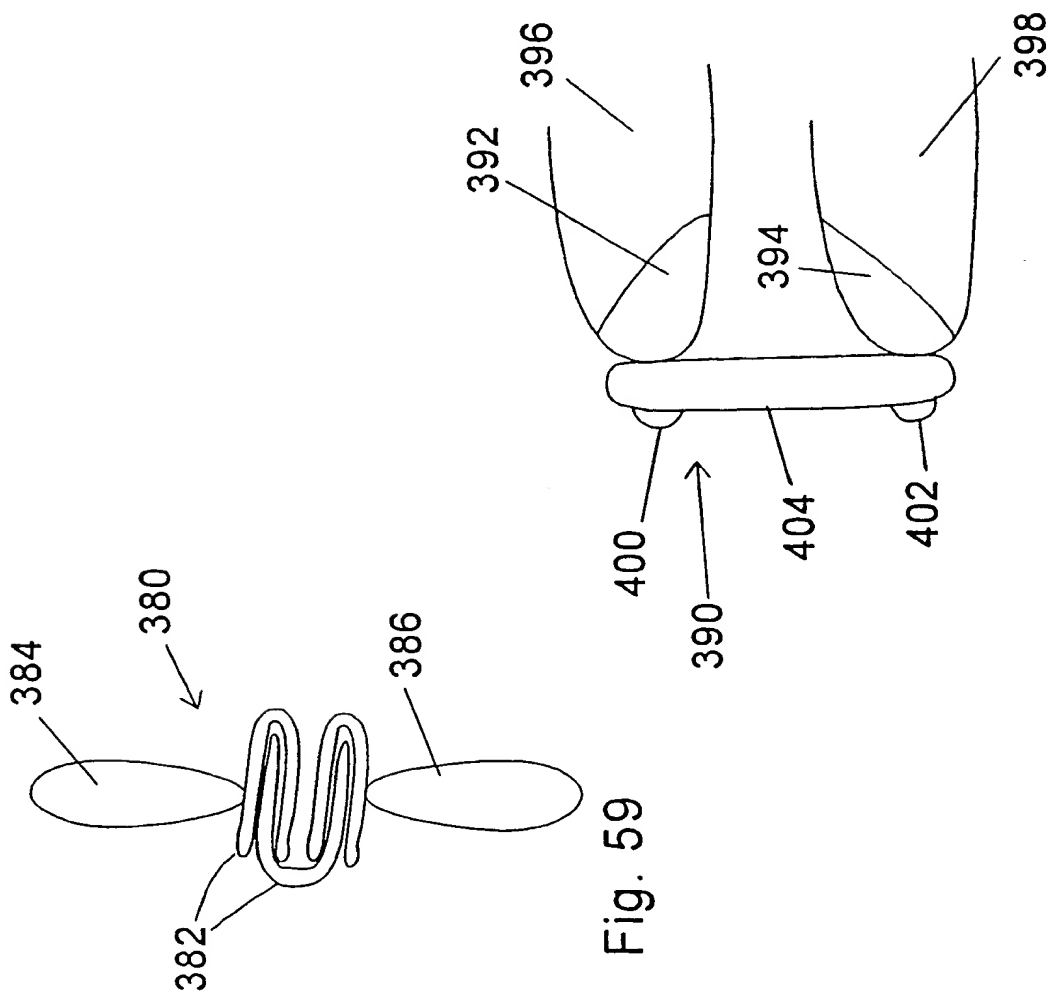


Fig. 59

Fig. 61

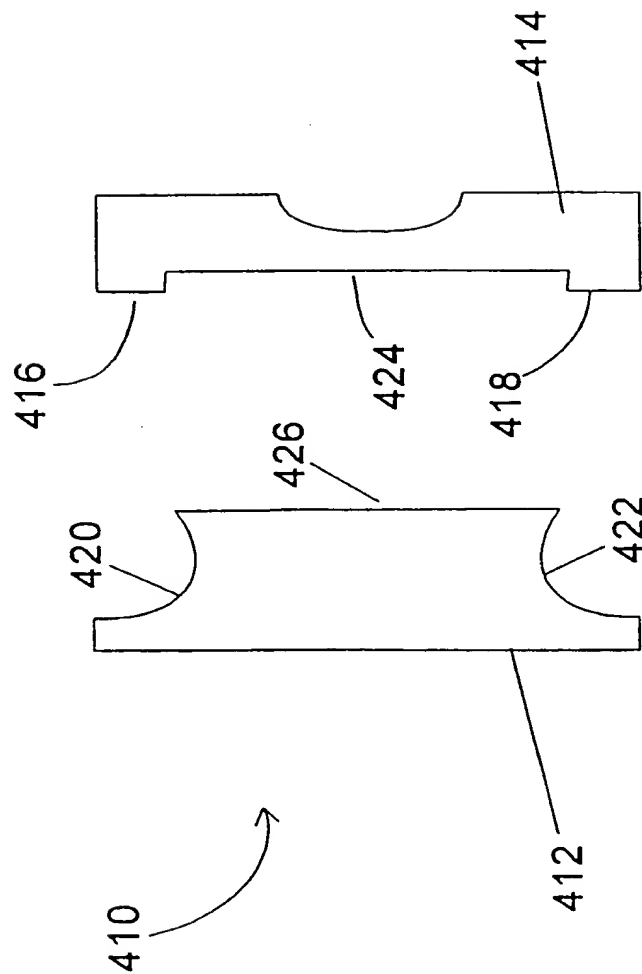


Fig. 62

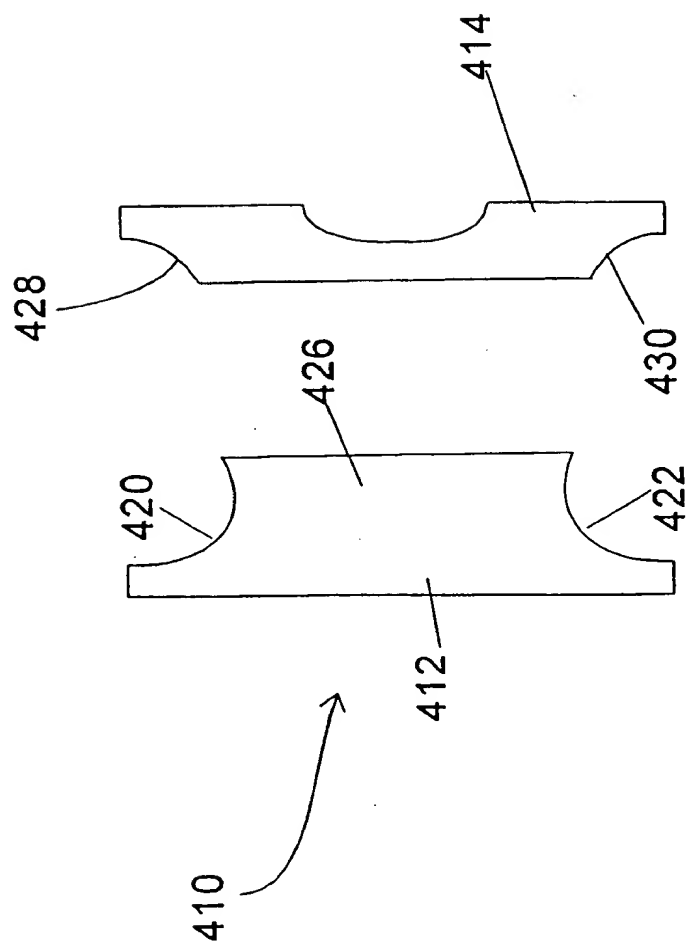


Fig. 63

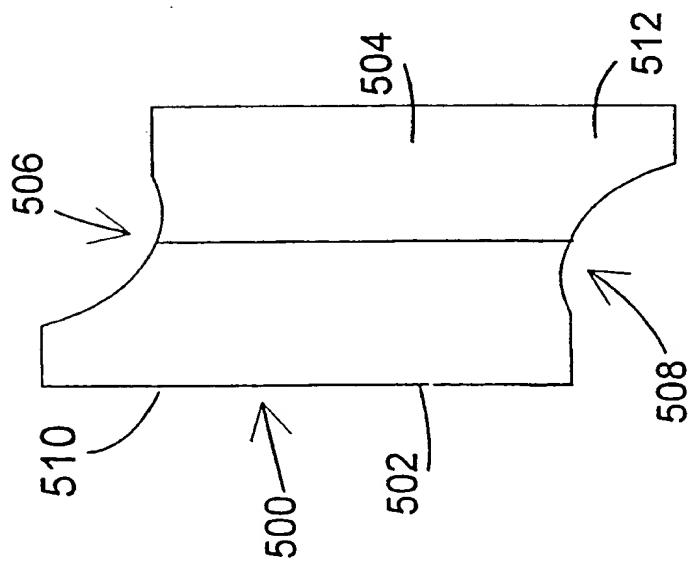


Fig. 64

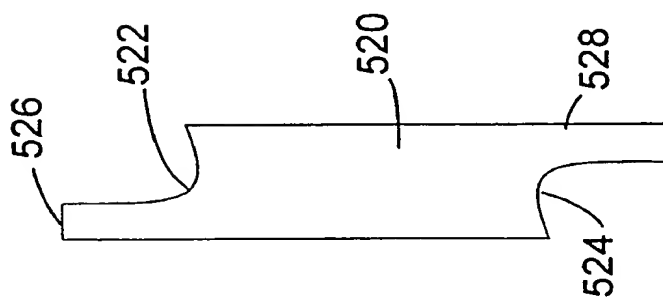


Fig. 65

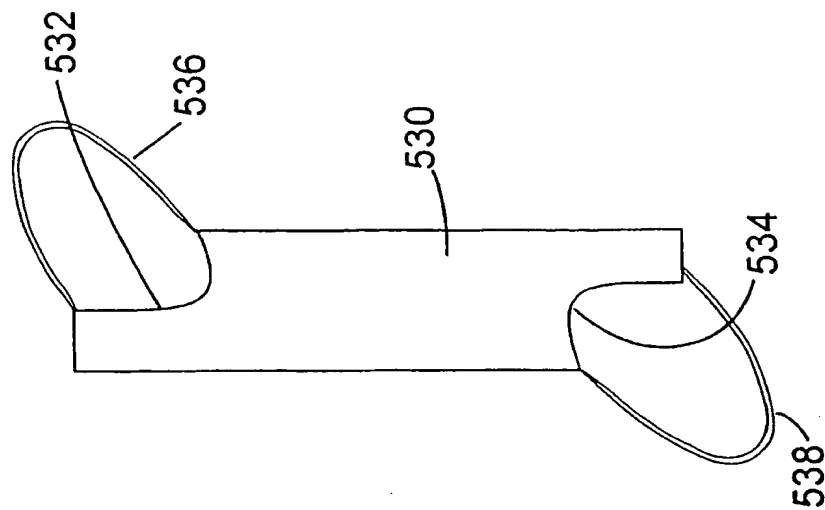


Fig. 66

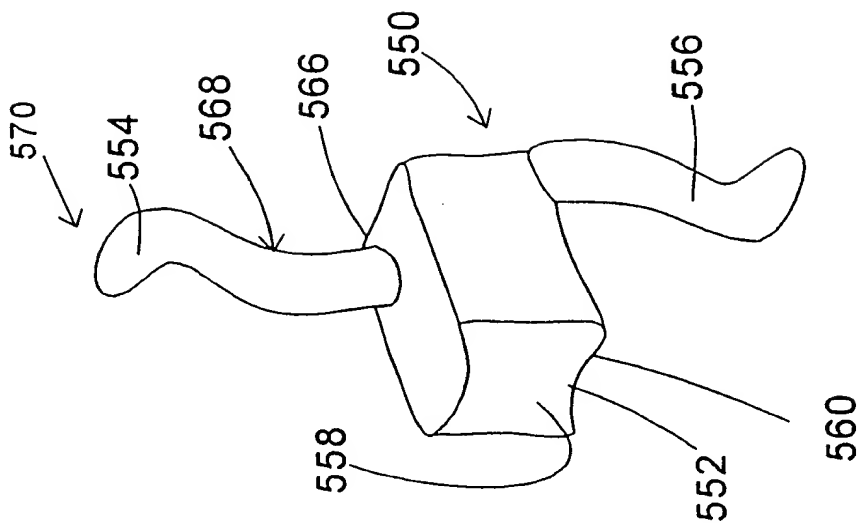


Fig. 68

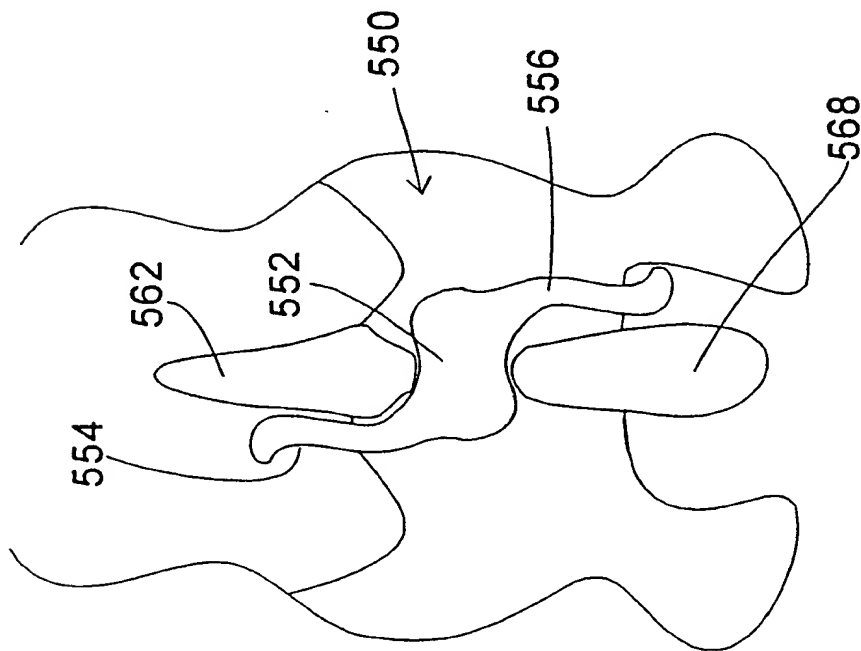
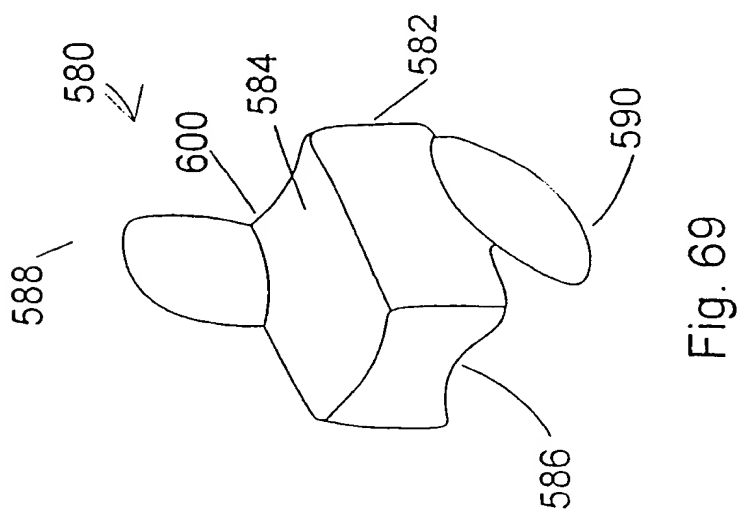
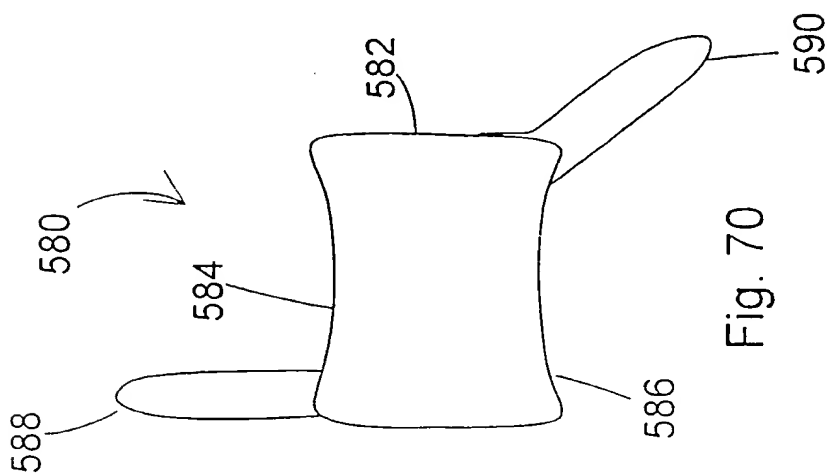
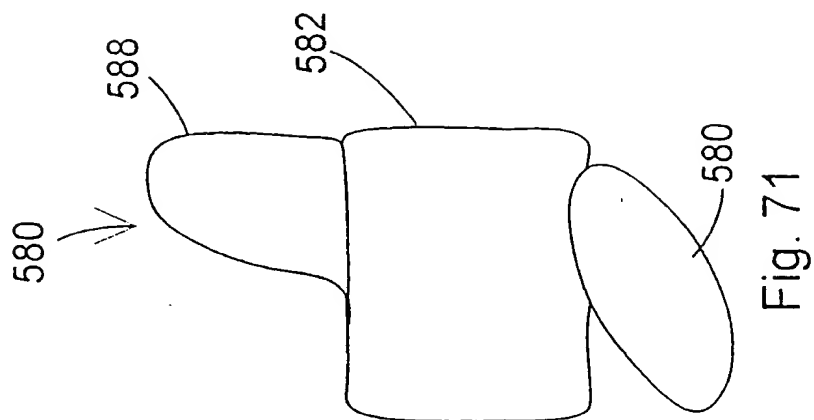


Fig. 67



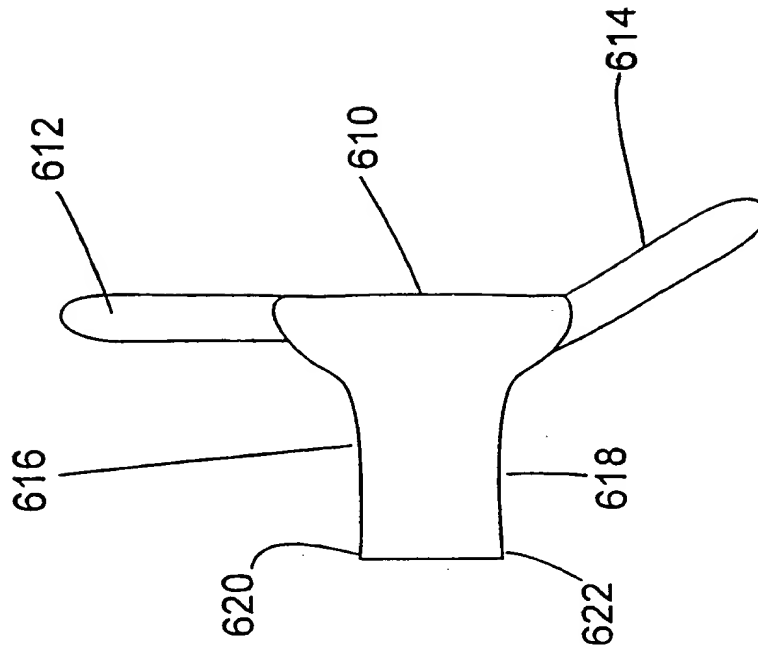


Fig. 71a

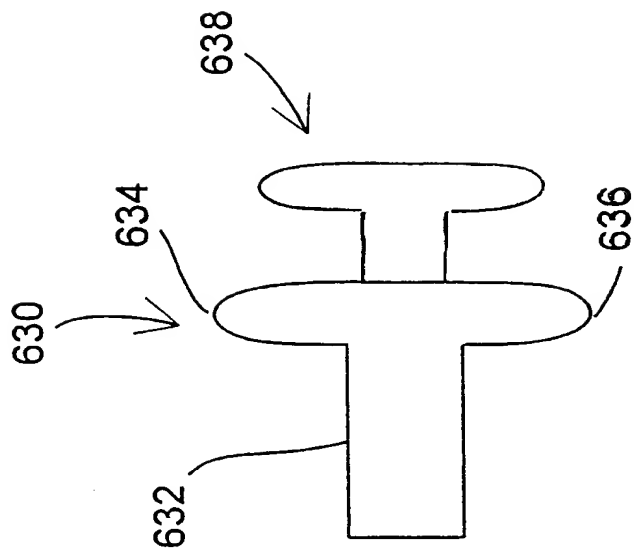


Fig. 72

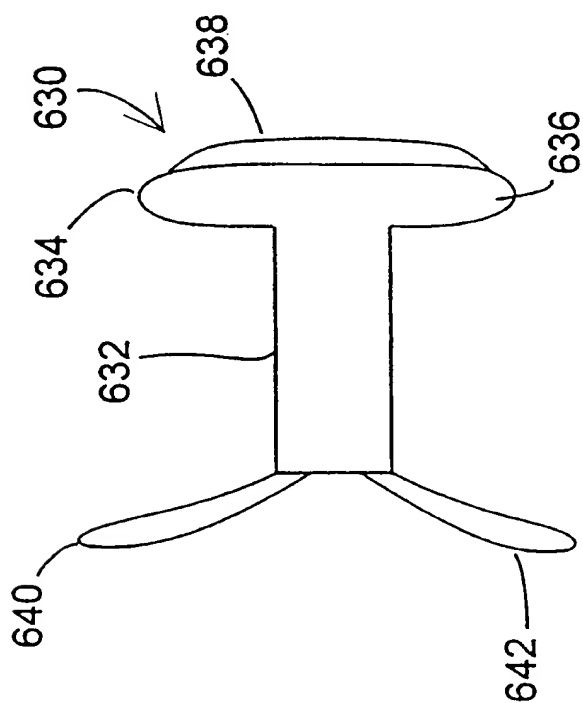


Fig. 73

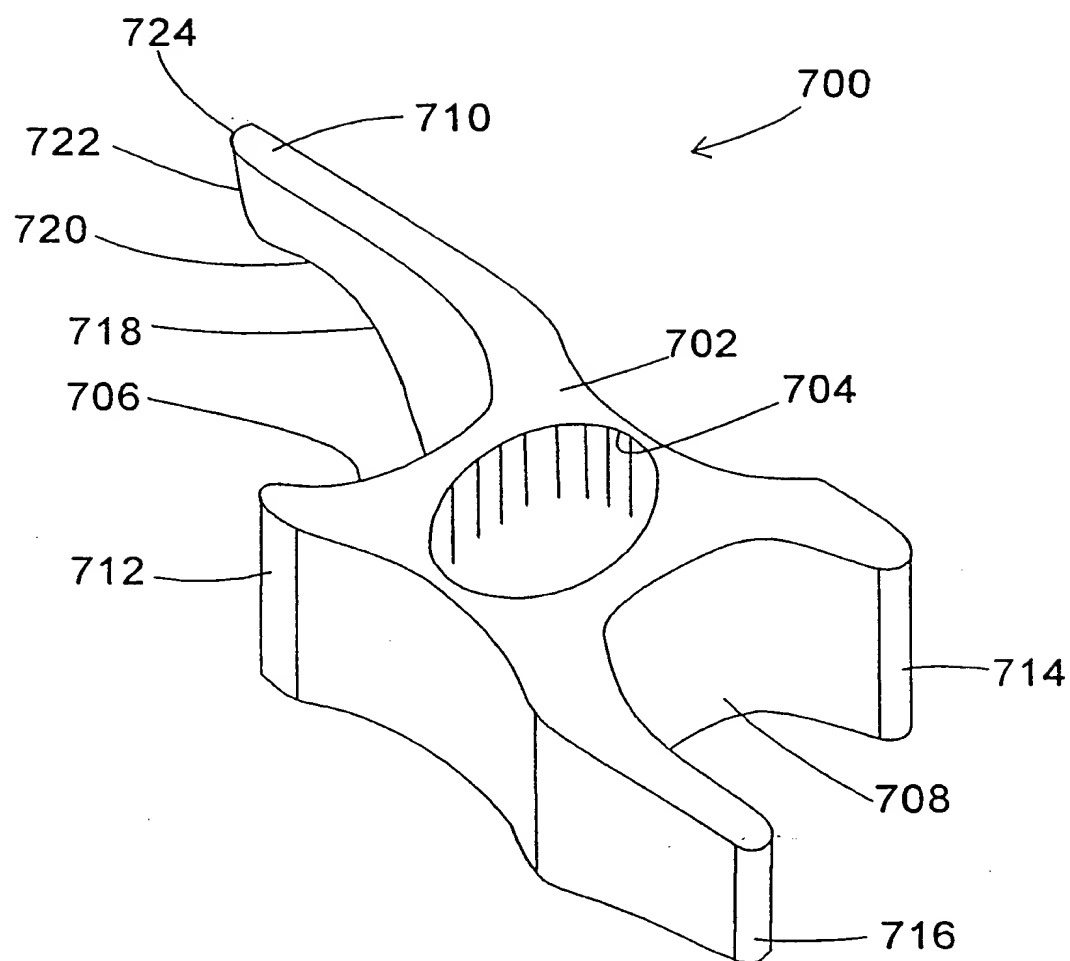


Fig. 74

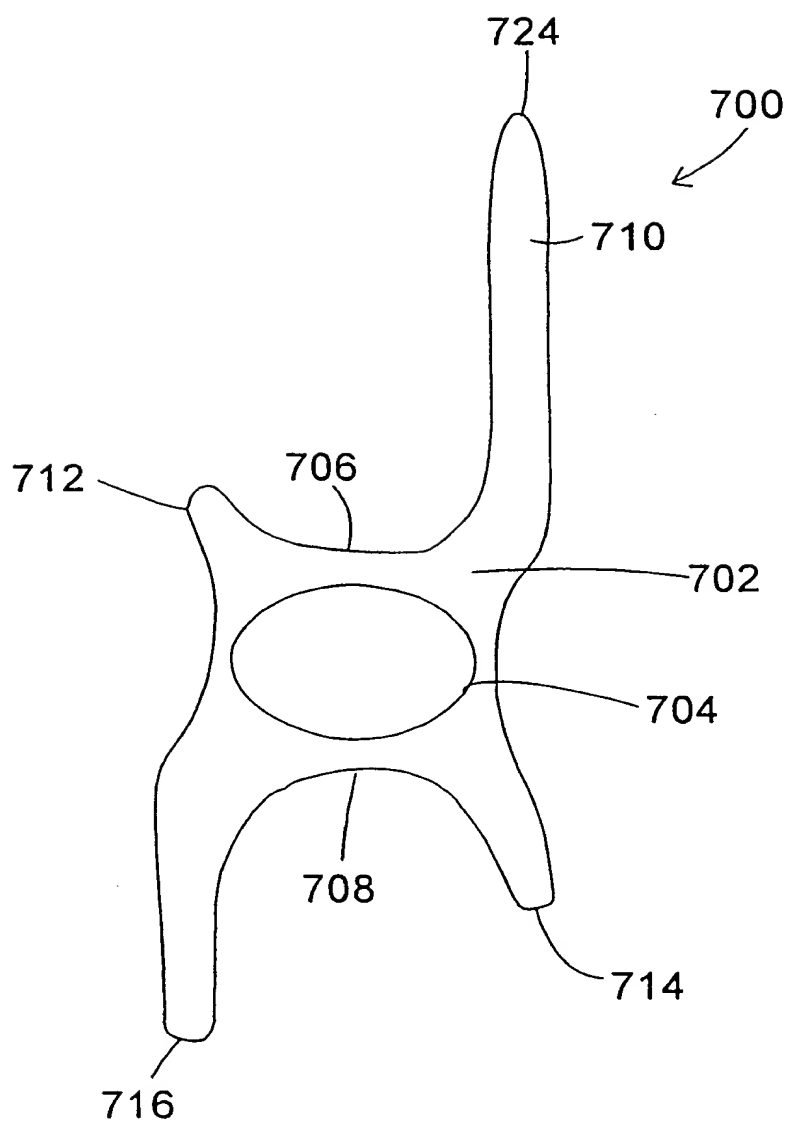


Fig. 75

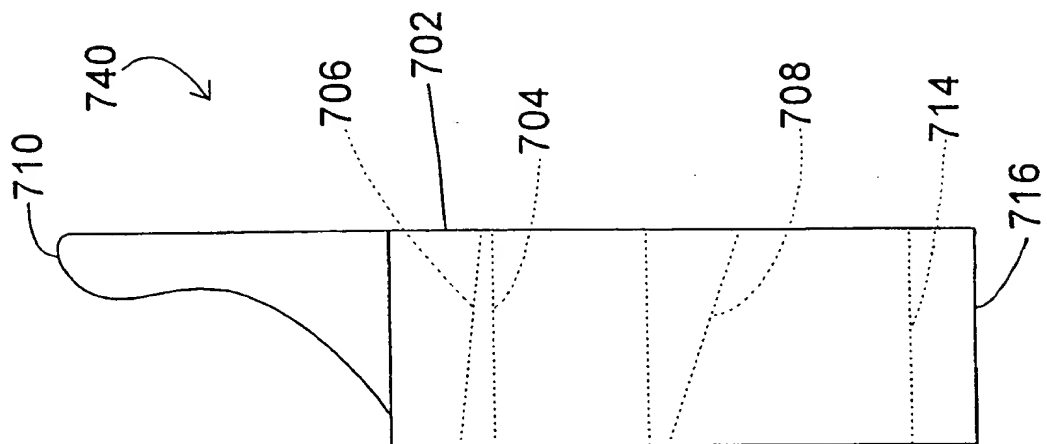


Fig. 77

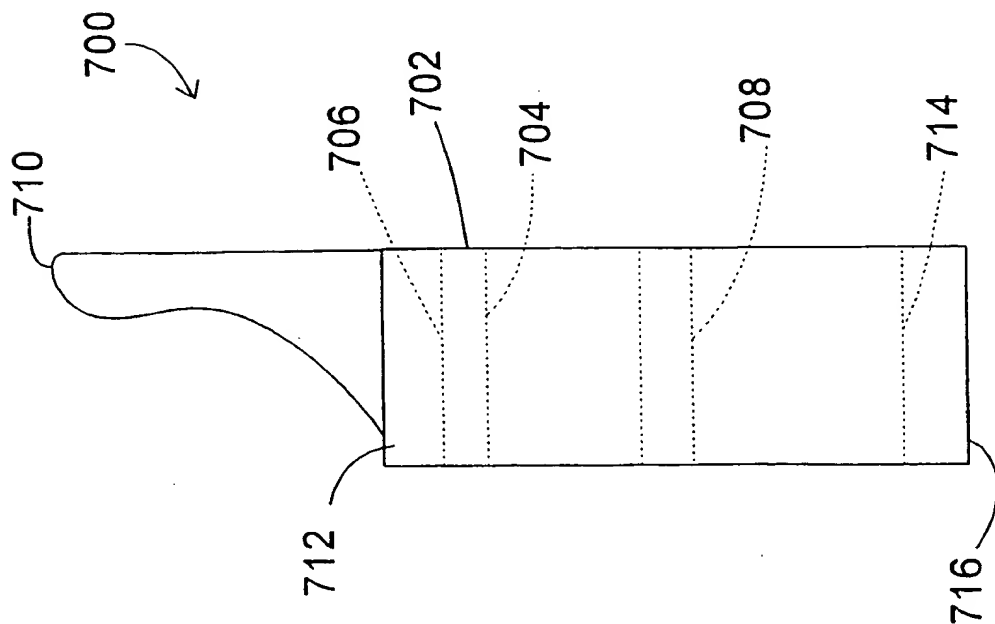


Fig. 76

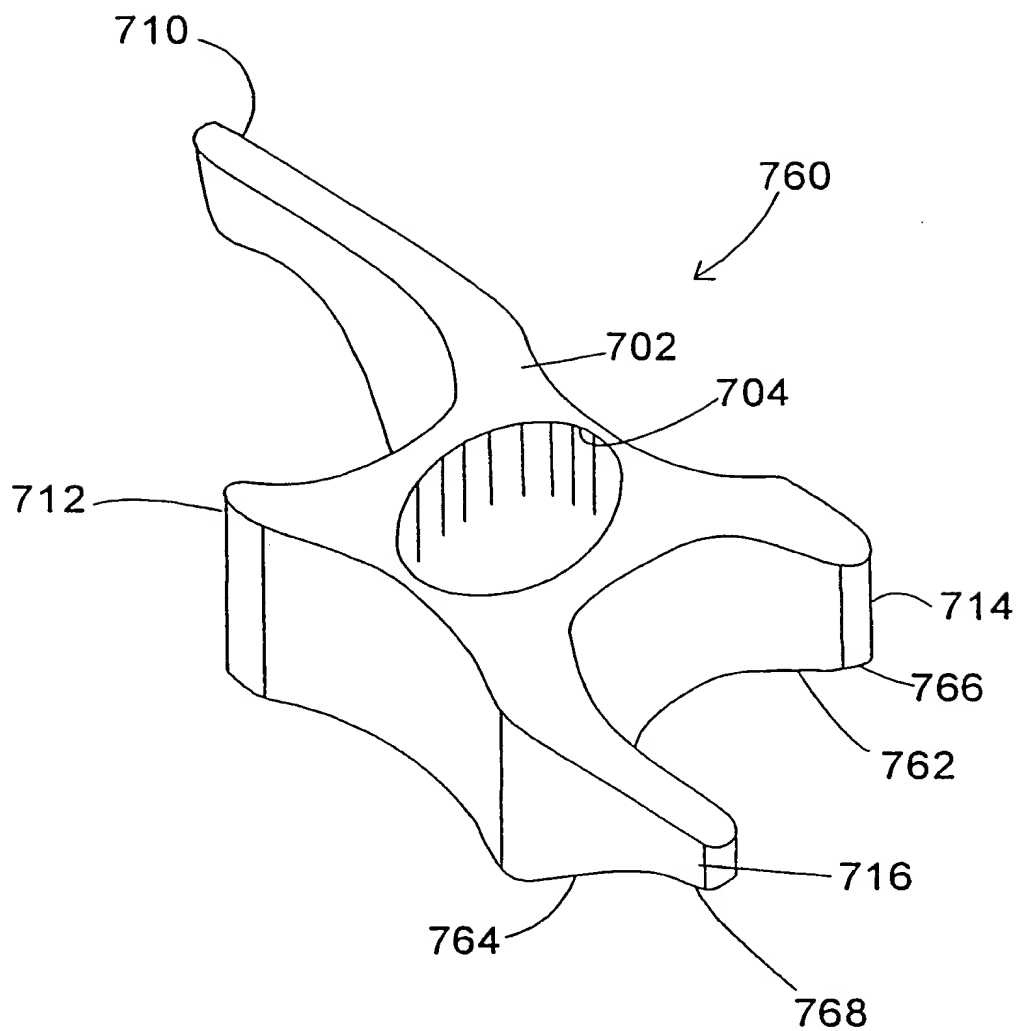


Fig. 78

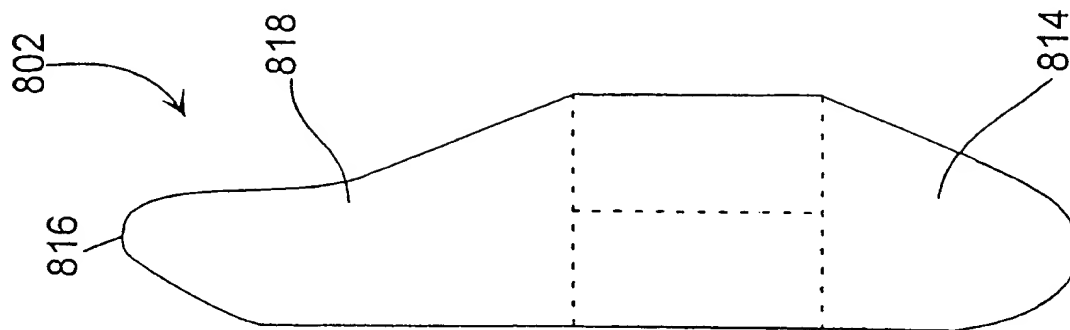


Fig. 81

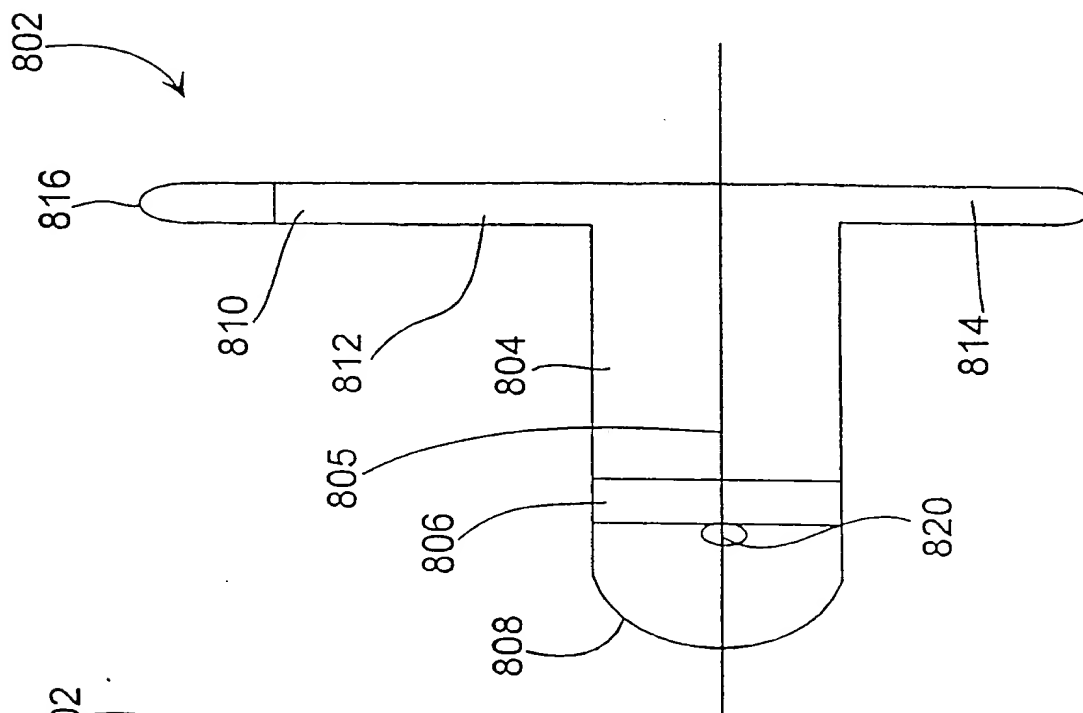


Fig. 80

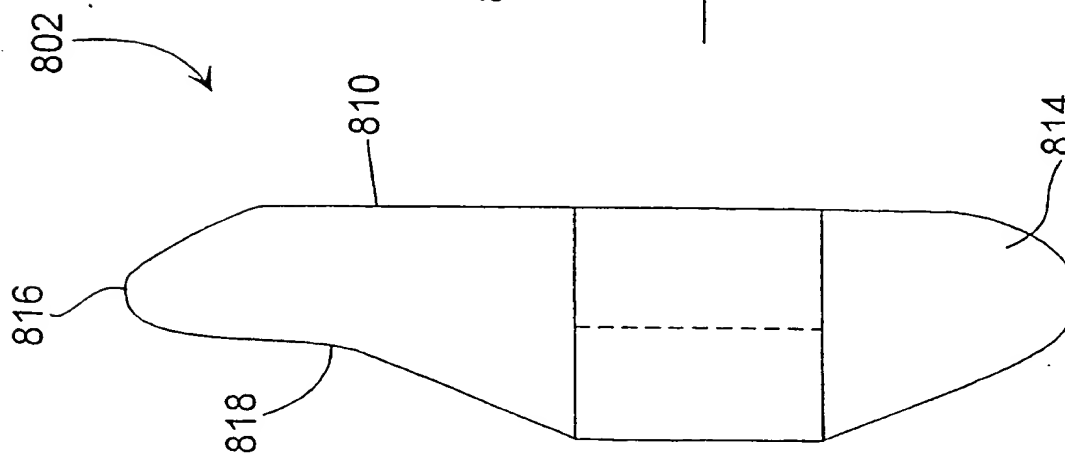


Fig. 79

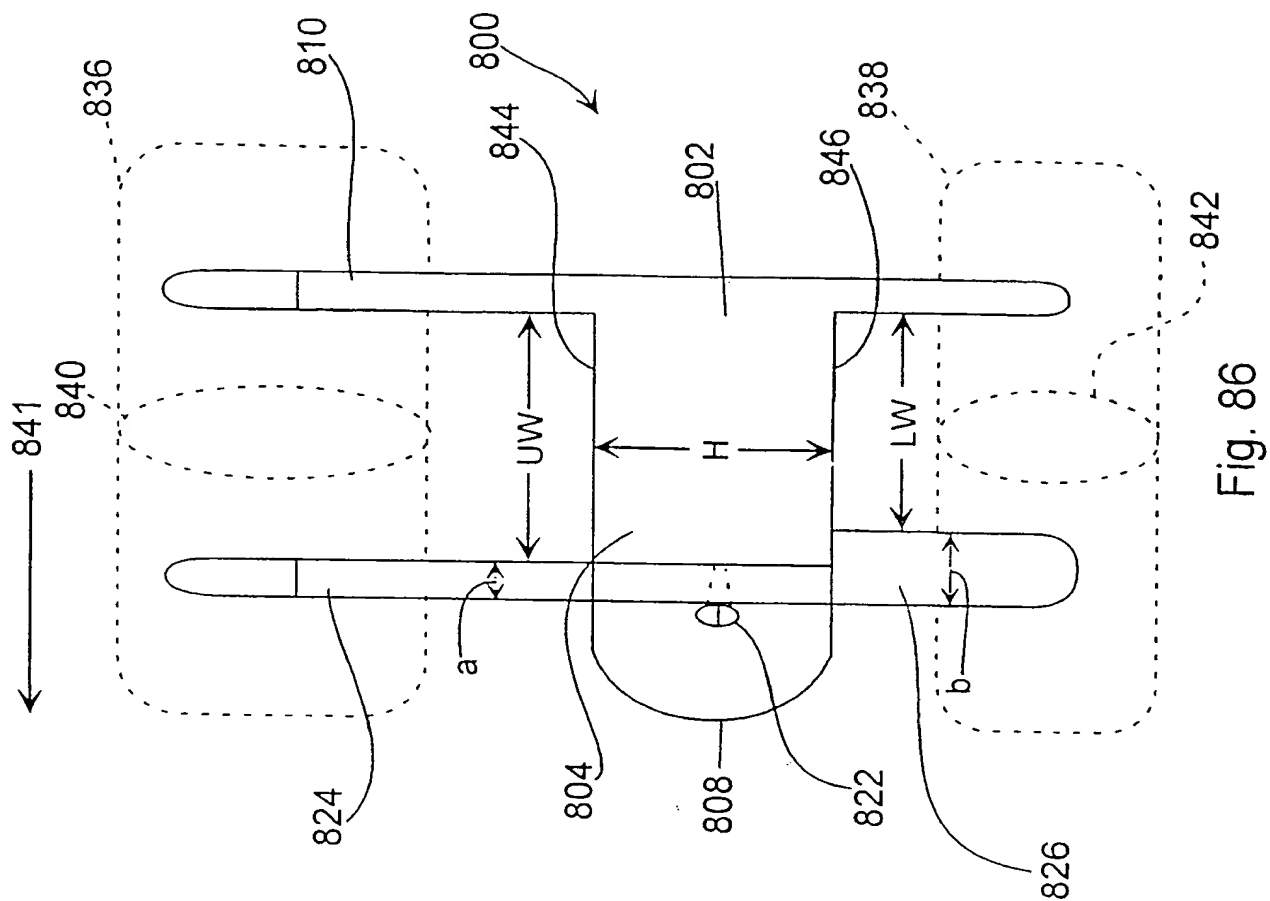
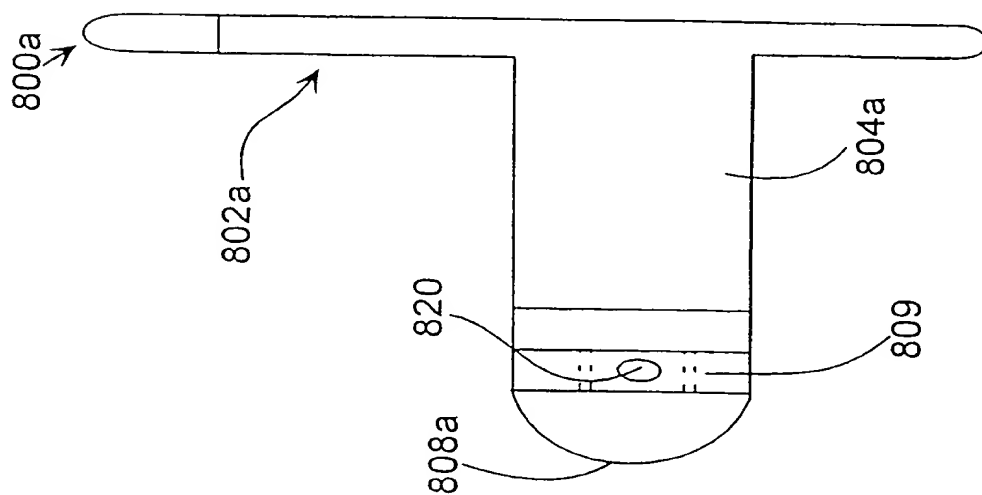


Fig. 80a



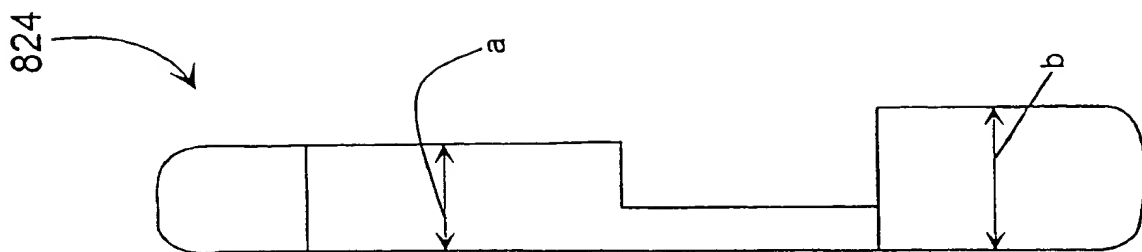


Fig. 83a

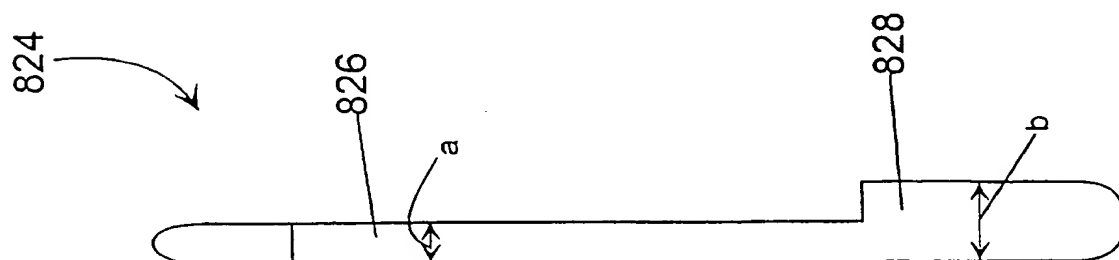


Fig. 83

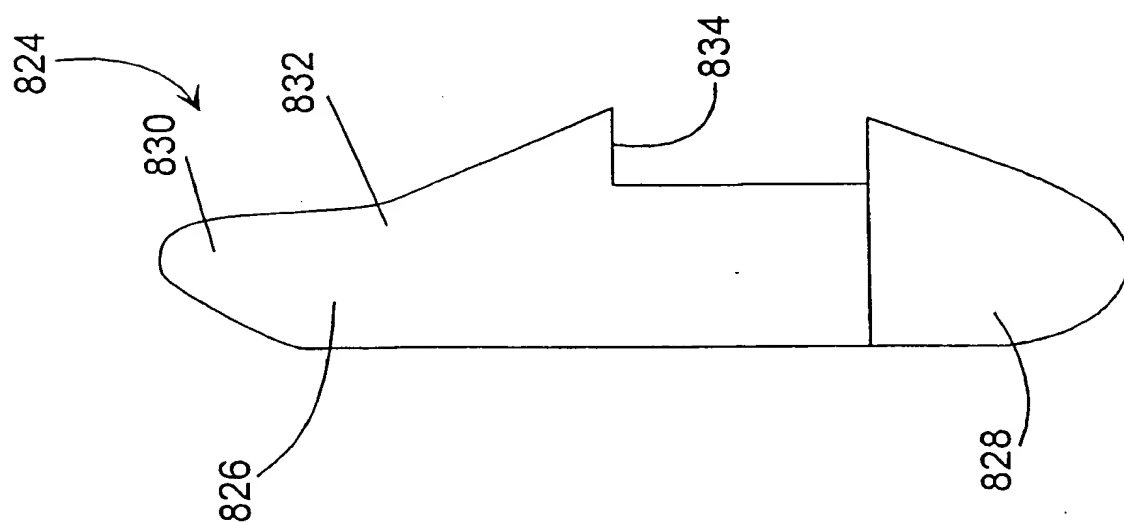


Fig. 82

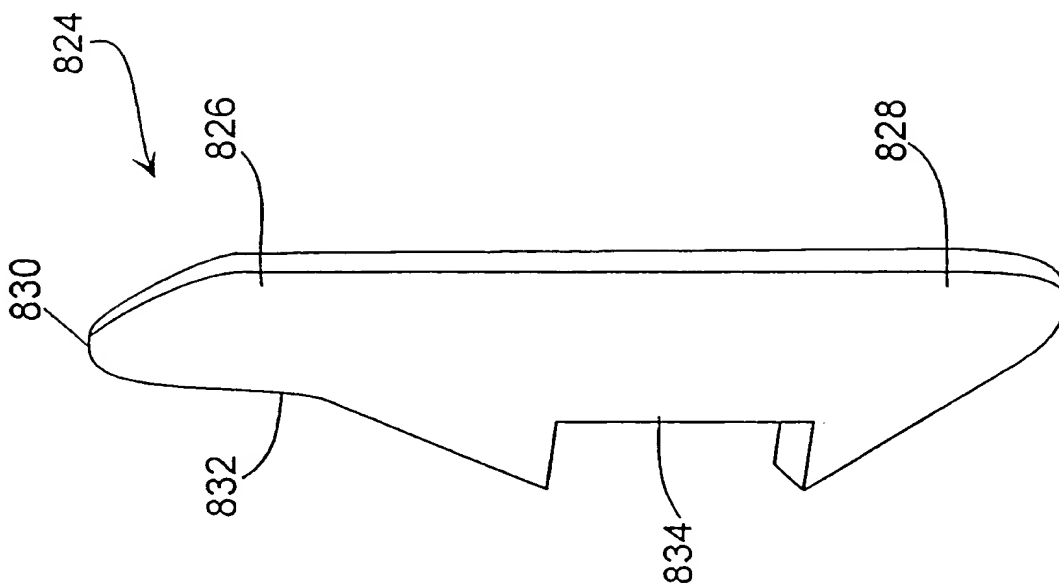


Fig. 85

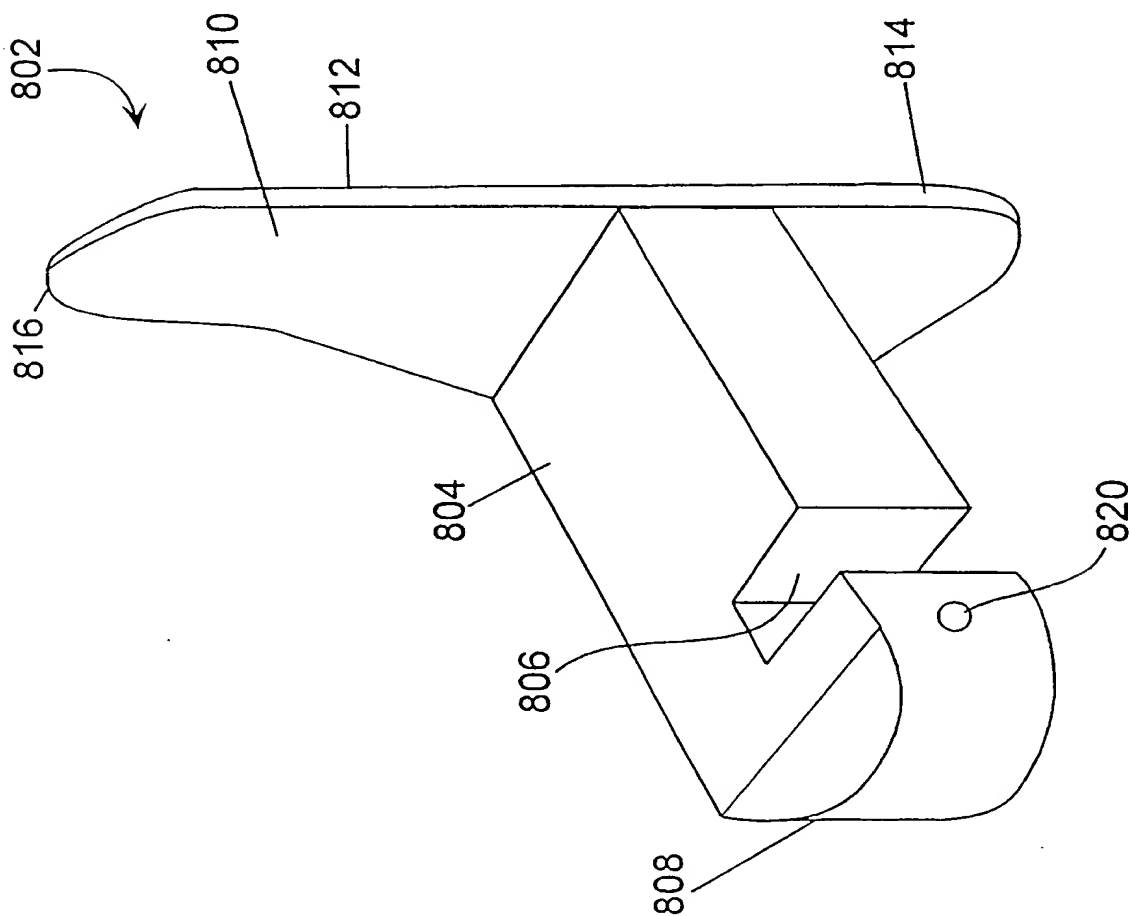


Fig. 84

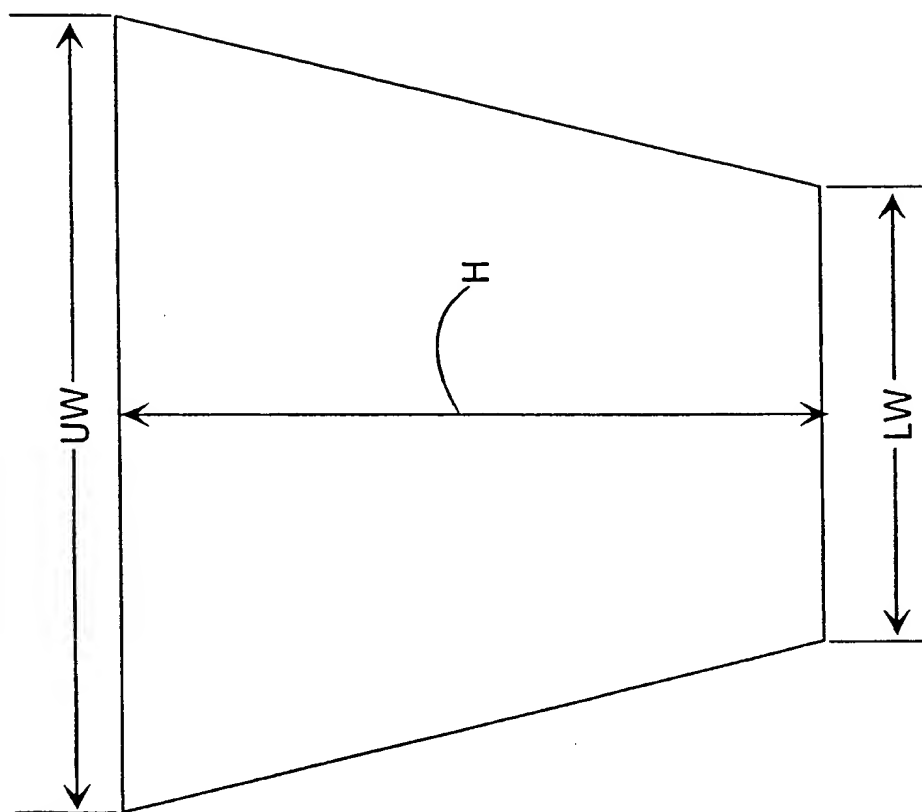
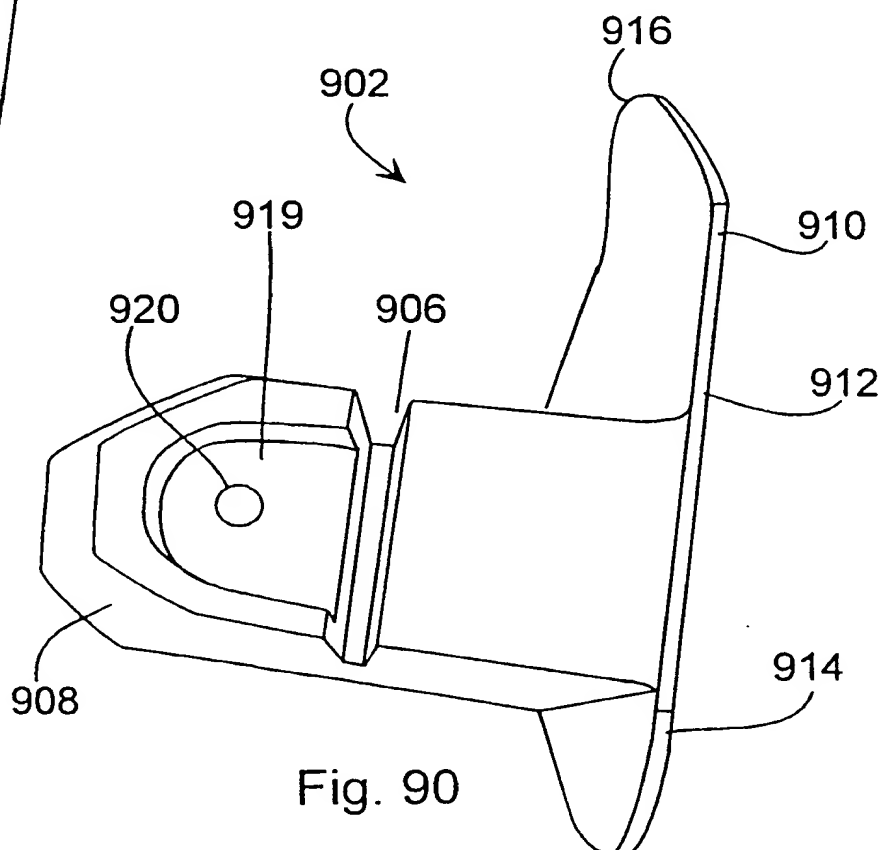
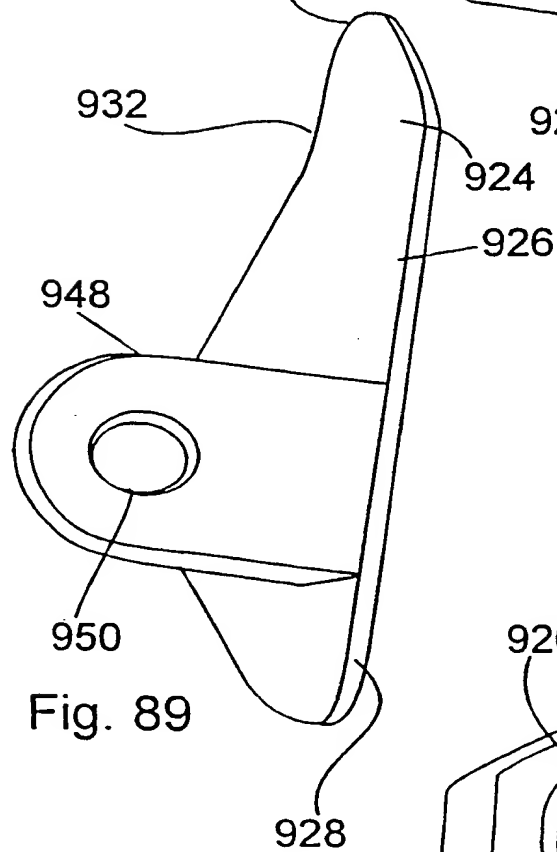
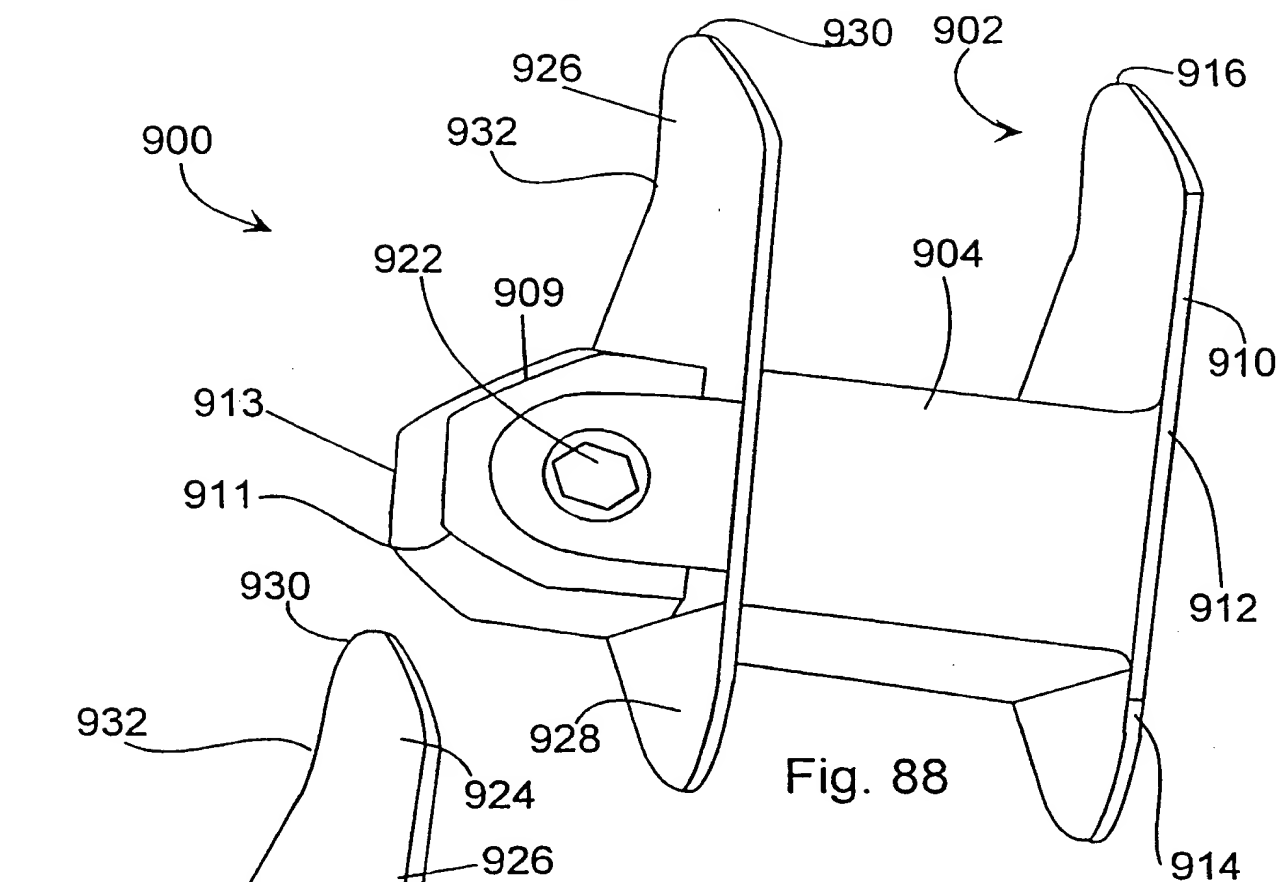


Fig. 87



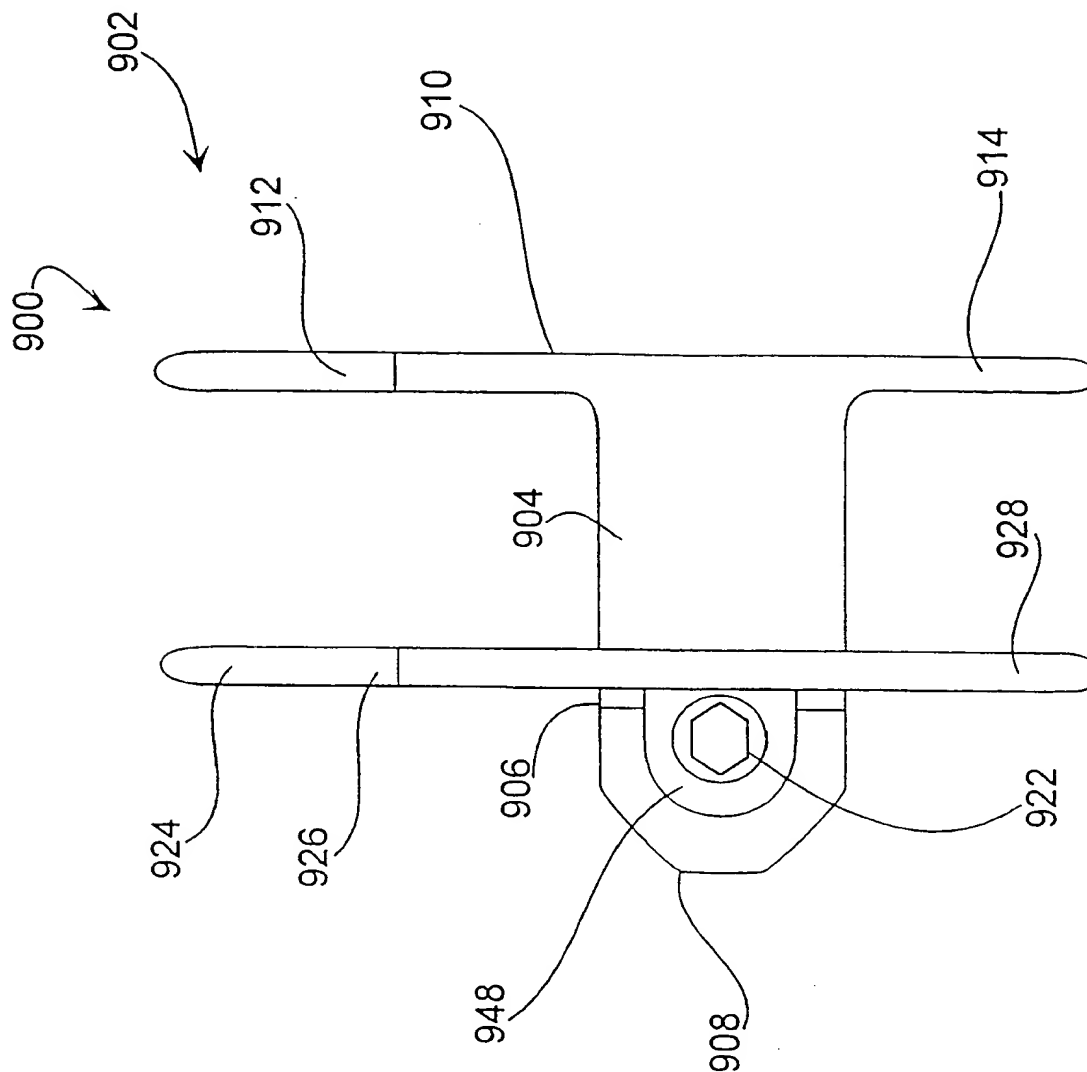


Fig. 91

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US97/23962

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :A61B 17/70

US CL :606/61

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 606/61,105; 623/17

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS

Search Terms: posterior process, spinous process, spine, spinal, flexion, extension

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 5,011,484 A (BREARD) 30 April 1991, Figs. 2, 3 and 5.	1-4, 7-10, 13, 17-21, 26-36, 60-66, 70, 71 ----- 5, 6, 11, 12, 37-44, 52, 53, 55-88, 67-69

☒ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents.	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
*A* document defining the general state of the art which is not considered to be of particular relevance	*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
*E* earlier document published on or after the international filing date	*Y* document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*Z* document member of the same patent family
*O* document referring to an oral disclosure, use, exhibition or other means	
*P* document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

30 APRIL 1998

Date of mailing of the international search report

20 MAY 1998

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## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US97/23962

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 5,496,318 A (HOWLAND et al) 5 March 1996, Figs. 5, 6 and 10-13.	90, 94-96, 98-100, 102, 103, 106-108, 110, 114, 115, 120, 121, 123 ----- 116, 117, 122, 123, 125-129
A,P	US 5,645,599 A (SAMANI) 08 July 1997, Figs. 1-4.	1-129

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